

SURVEYS OF THE FISH RESOURCES OF

São Tomé & Príncipe

Survey of the demersal resources
10 May - 20 May 2010

Direcção das Pescas
São Tomé and Príncipe

Institute of Marine Research
Norway

Bergen November 2010



THE EAF-NANSEN PROJECT

FAO started the implementation of the project "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)" in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen project is a follow-up to earlier projects/programmes in a partnership involving FAO, Norad and the Institute of Marine Research (IMR), Bergen, Norway on assessment and management of marine fishery resources in developing countries. The project works in partnership with governments and also GEF-supported Large Marine Ecosystem (LME) projects and other projects that have the potential to contribute to some components of the EAF-Nansen project.

The EAF-Nansen project offers an opportunity to coastal countries in sub-Saharan Africa, working in partnership with the project, to receive technical support from FAO for the development of national and regional frameworks for the implementation of Ecosystem Approach to Fisheries management and to acquire additional knowledge on their marine ecosystems for their use in planning and monitoring. The project contributes to building the capacity of national fisheries management administrations in ecological risk assessment methods to identify critical management issues and in the preparation, operationalization and tracking the progress of implementation of fisheries management plans consistent with the ecosystem approach to fisheries.

LE PROJET EAF-NANSEN

La FAO a initié la mise en oeuvre du projet "Renforcement de la base des connaissances pour mettre en oeuvre une approche écosystémique des pêcheries marines dans les pays en développement (EAF-Nansen GCP/INT/003/NOR)" en décembre 2006. Le projet est financé par de l'Agence norvégienne de coopération pour le développement (Norad). Le projet EAF-Nansen fait suite aux précédents projets/ programmes dans le cadre du partenariat entre la FAO, Norad et l'Institut de recherche marine (IMR) de Bergen en Norvège, sur l'évaluation et l'aménagement des ressources halieutiques dans les pays en développement. Le projet est mis en oeuvre en partenariat avec les gouvernements et en collaboration avec les projets grands écosystèmes marins (GEM) soutenus par le Fonds pour l'Environnement Mondial (FEM) et d'autres projets régionaux qui ont le potentiel de contribuer à certains éléments du projet EAF-Nansen.

Le projet EAF-Nansen offre l'opportunité aux pays côtiers de l'Afrique subsaharienne partenaires de recevoir un appui technique de la FAO pour le développement de cadres nationaux et régionaux visant une approche écosystémique de l'aménagement des pêches et la possibilité d'acquérir des connaissances complémentaires sur leurs écosystèmes marins. Ces éléments seront utilisés pour la planification et le suivi des pêcheries et de leurs écosystèmes. Le projet contribue à renforcer les capacités des administrations nationales responsables de l'aménagement des pêches en introduisant des méthodes d'évaluation des risques écologiques pour identifier les questions d'aménagement d'importance majeure ainsi que la préparation, la mise en oeuvre et le suivi des progrès de la mise en oeuvre de plans d'aménagement des ressources marines conformes à l'approche écosystémique des pêches.

CRUISE REPORTS "DR. FRIDTJOF NANSEN"

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Jens-Otto Krakstad and Oddgeir Alvheim

Institute of Marine Research
P.O. Box 1870 Nordnes
N-5817 Bergen, Norway

Jose Dias de Sousa Lopes

Direcção das Pescas, São Tomé and Príncipe

and

Tomio Iwamoto

California Academy of Sciences,
California, USA

**Institute of Marine Research
Bergen, 2010**

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CHAPTER 1 INTRODUCTION

The oceanic islands of São Tomé and Príncipe form a portion of a string of elevations extending along a geologic feature known as the Guinea Line (or Cameroon Volcanic Line), which on the African continent include the Jos Plateau of Nigera, the Cameroon Highlands, and Mount Cameroon. The Guinea Line extends into the ocean at the continental island of Bioko (formerly Fernando Poo), with the 31 million years old Príncipe approximately 220 km southwest of Bioko, and the 13 million years old São Tomé another 146 km farther south. Annobón (or Pagalu) (180 km from São Tomé) is the southernmost of this string of islands, of which the three southernmost ones are surrounded by ocean depths greater than 3000 m. São Tomé (836 km²) is much larger in land area than Príncipe (130 km²), but if measured from the shelf break, Príncipe would be somewhat larger, as the southern part of the volcanic peak that forms the island appears in bathymetric charts to form a broad shelf to depths of approximately 100 m, beyond which the bottom drops precipitously. In fact, almost two-thirds of the total continental-shelf area of the country lies around Príncipe. (Most of the data given above is from R. C. Drewes & J. A. Wilkinson, 2004. *Proc. Calif. Acad. Sci.* 55(20):395-407). The remoteness of these oceanic islands and the long isolation they have experienced have had pronounced effects on the composition of their biota. For example, the islands' avifauna has the highest percentage of endemic taxa in the world. Recent studies on the other groups of plants and animals have shown a similar high degree of endemism. Anuran diversity is amazingly high, considering that members of that group are among the least capable of transiting oceanic expanses, and the amount of endemism they show reflect the long isolation the islands have experienced since their births.

The survey of São Tomé and Príncipe was a follow up from the successful surveys conducted by Institute of Marine Research (IMR) and Food and Agriculture Organisation of the United Nations (FAO) in the region in 2004, 2005, 2006 and 2007 in cooperation with the Guinea Current Large Marine Ecosystem, (GCLME), FAO and IMR.

The present survey was organised by IMR and FAO under the FAO project CCP/INT/003/NOR: "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries. This project is the continuation of a series of projects and agreements between NORAD, IMR and FAO involving surveys with the research vessel "Dr. Fridtjof Nansen".

1.1 Objectives

Following the instructions from the Direcção das Pescas, São Tomé and Príncipe and the recommendations from the pre survey meeting held onboard the vessel the main objectives of the survey were:

- to describe the distribution, composition and estimate the abundance of the main demersal fish species on the shelf by a swept-area trawl programme
- to map the general hydrographic regime by using a CTD to monitor the temperature, salinity and oxygen at bottom trawl stations and on hydrographical transects
- To specially watch out for observed dead fish of the genus *Lagocephalus*
- on-the-job training covering main survey routines

1.2 Participation

Participants for the survey came from:

Direcção das Pescas, São Tomé and Príncipe:

Virginia Carvalho Godinho, André Bandeira, Leonel Ferreira Nunes da Mota, Jose Dias de Sousa Lopes (local team leader) and Ilair de Conceição

California Academy of Sciences, USA:

Tomio Iwamoto

Institute of Marine Research, Bergen, Norway:

Jens-Otto Krakstad (cruise leader), Oddgeir Alvheim, Tore Mørk and Thor Egil Johansson

1.3 Narrative

The vessel left Tema (Ghana) at 18:00 on the 7th May. and continued across to the islands of São Tomé and Príncipe. Local scientists came on board in São Tomé in the afternoon of the 10th May. Príncipe was surveyed from the morning of the 11th May to the evening of 13th May before the vessel crossed over to São Tomé. The swept area survey of São Tomé was carried out from the 14th May in the morning until the 16th May in the evening. The Norwegian National day, 17th May, was celebrated at anchor at the south eastern side of the island. From the 18th May midday until the 19th May in the evening a diurnal trawl experiment was performed on two preselected stations with the purpose of inspecting the variation in fish catch size and species composition over a 24 h period. During this experiment each trawl station were trawled every 5 h throughout. The survey ended on the 20th May in the morning when the vessel arrived back in the port of São Tomé.

The bottom topography on the island limits the trawlable areas and does not allow for a fully random selection of trawl stations. Semi random swept area trawl stations using the depth zones 20-50 m, 51-100 m and when possible >100 m depth were conducted during the day while CTD lines, were carried out at night. Continuous acoustic registrations were recorded

throughout the survey. Pelagic trawling on registrations and random blind hauls was carried out during dark hours when time permitted.

CTD-stations were taken at the bottom trawl stations. In addition, hydrographical profiles were made with CTD from surface down to the bottom or 1500 m depth.

1.4 Survey effort

Figure 1.1 shows the cruise tracks with trawl and hydrographic stations.

Table 1.1 summarises the survey effort in each island. The area calculated for São Tomé and Príncipe is the total area for both islands for the depth regions surveyed.

Table 1.1 Surveyed area and valid trawl stations by depth stratum (in brackets pelagic trawls), total trawl stations separated by bottom (BT) and pelagic (PT), plankton hydrographic stations (CTD) and distance surveyed in NM by region.

Region	Depth strata (m)			Total				
	20-50	51-100	101-200	BT	PT	Plankton	CTD	Distance
Príncipe Area (NM ²)	68	58	-					
#hauls	4	9	-	13	2	2	36	360
São Tomé Area (NM ²)	71	228	-					
#hauls	2	6	-	8	4	6	47	550

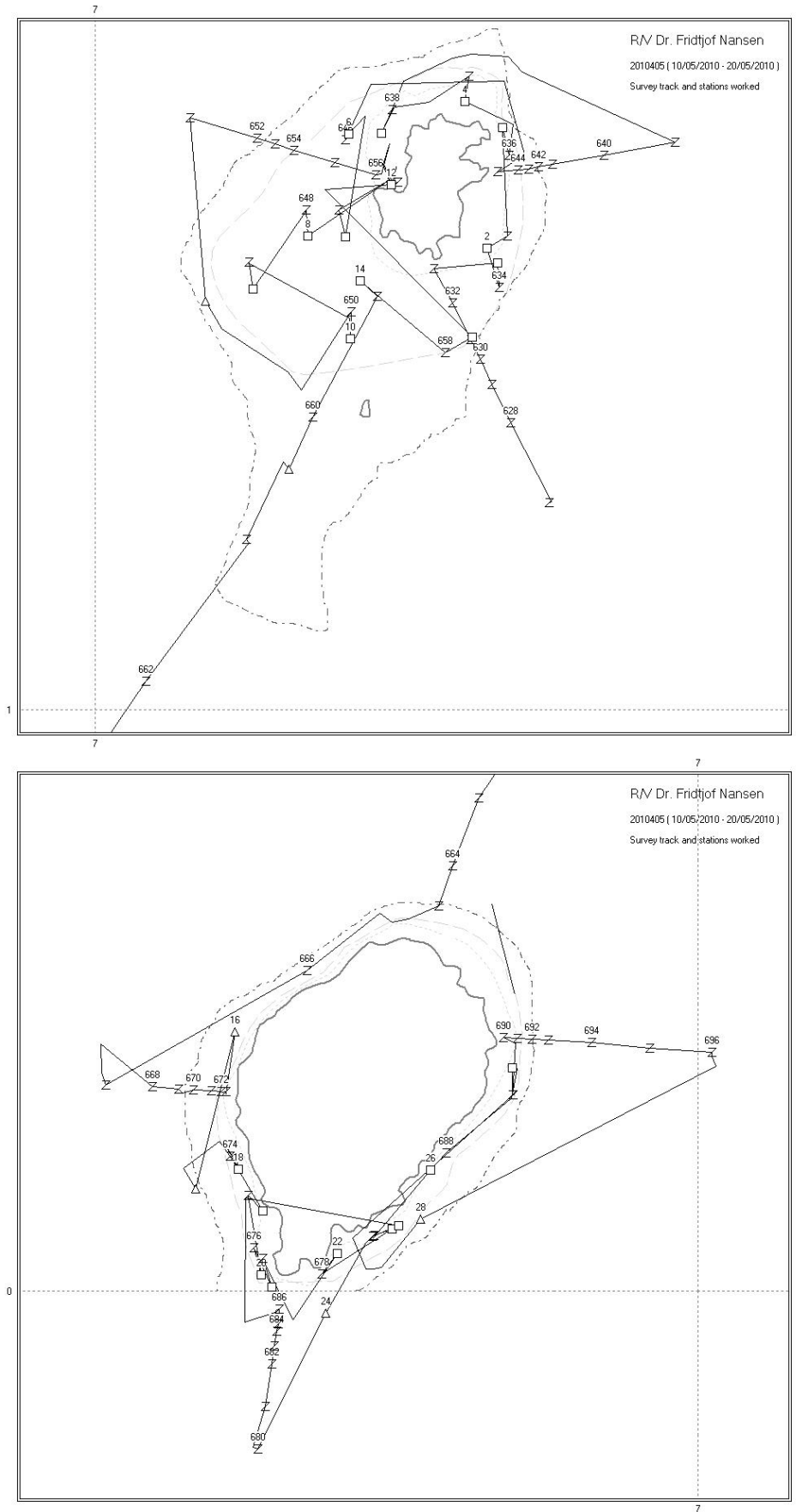


Figure 1.1 Course track with fishing, plankton and hydrographic stations São Tomé and Príncipe. Depth contours are indicated

CHAPTER 2 METHODS

2.1 Meteorological and hydrographical sampling

Temperature, salinity and oxygen

A Seabird 911 CTD plus was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were usually taken down to a few metres above the bottom, but not deeper than 1 500 m.

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity and relative temperature and fluorescence (5 m depth) every 10 seconds. An attached in-line Turner Design SCUFA Fluorometer continuously measured Chlorophyll A levels [RFU] at 5 m below the sea surface while underway during the entire cruise.

Meteorological observations including wind direction and speed, air temperature, global radiation and sea surface temperature (SST) were automatically logged using a WIMDA meteorological station and averaged by every nautical mile distance sailed.

A vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments logged the current profiles continuously, and was set to ping synchronously with the echo sounders. The frequency of the VMADCP is 150 kHz, and data were averaged and stored in 4 m vertical bins in shallow water to approximately 400 m bottom depth and 8 m bins deeper than this.

Zooplankton

The sampling was conducted by means of HYDROBIOS Multinet with 5 nets. The nets (180 μm) were remotely opened from the bridge of the vessel. The depth intervals covered in 2010 were: 200-100 m, 100 -75 m, 75-50 m, 50-25 m and from 25 m to the surface. In the case of stations shallower than 25 m, the sample was taken from the bottom and up to the surface. A SCANMAR depth sensor gave real-time information of the depth and a flow meter inside the net was used to estimate the sampling volume.

2.2 Biological sampling

Sampling gear

A Gisund Super bottom trawl with a headline height of about 4.5 m was used during the survey, and the doors are of the Thyborøn' combi type. The distance between the front parts

of the wings was about 21 m during deployment at a speed of 3 NM h⁻¹. These settings have been the standard on all swept area surveys with R/V “Dr. Fridtjof Nansen”. During all tows deeper than 80 m, a 9 m long constraining rope was attached between the wires 120 m in front of the trawl doors. This kept a constant distance between the doors of about 50 m during the trawling. In shallow stations with depths of less than 80 m, the door-to-door distance varied more, depending on bottom type and currents. Data from the door and depth/trawl-height sensors were logged for all tows and are stored in files with CMG format, which makes it possible to study the trawl performance in more detail.

Trawl duration was standardized to 30 minutes. The trawling start time is controlled by using SCANMAR sensors to detect the landing of the trawl on the bottom, and the stop-time is defined as the time when the wires start to haul the net. In some cases the towing was interrupted before 30 minutes either due to poor bottom conditions or too high catches of fish indicated by the installed catch sensors. If the stations were not trusted to reflect the density of fish on the bottom they were recorded as invalid in the Nansis database. Table 2.1 shows the numbers of valid and invalid stations.

Catch Sampling

The trawl catches were sampled for species composition by weight and numbers. The deck sampling procedure is described in more detail by Strømme (1992). Length measurements (total length) were taken for target species. The length of each fish was recorded to the nearest 1 cm below. The mantle length was measured to the nearest 1 cm below for *Sepia* spp. In addition, at a few stations total length and body weight (g) were recorded. Basic information recorded at each fishing stations, i.e. trawl hauls, is presented in Annex I. Pooled length frequency distributions, raised to catch per hour, of selected species are shown in Annex II. The swept-area estimates are presented in Annex III. A description of the fishing gears used, acoustic instruments and their standard settings is given in Annex IV.

Samples for the marine biodiversity collection

An attempt was made to take a tissue sample of every species captured, and preserve at least one individual of each to serve as voucher specimens deposited in the research collections of the California Academy of Sciences. In a few instances, the specimens from which tissues were taken were too large to preserve, so a photograph was taken of the sampled specimen to serve as the voucher. In a few instances, specimens representing species that were hitherto not recorded from the islands were discarded by the sorting crew before they could be retrieved and preserved. Fortunately, such instances were few, and improved procedures that were implemented during the survey ensured that such things did not happen more often.

2.3 Biomass estimates

Biomass estimates based on swept-area method

In the bottom trawl survey, stock biomasses was estimated by the swept-area method with catch per haul as the index of abundance (see Strømme 1992). The general formula to estimate biomass B, using this method is:

$$B = \frac{A}{a} \cdot \frac{\bar{X}}{q}$$

A is the total area surveyed, a is the swept area of the net per haul, \bar{X} is the average catch per haul (the index of abundance) and q is the proportion of fish in the path of the net that are actually caught. The density of the resource is estimated as biomass per unit area. In a stratified survey of k non-overlapping strata, if the mean catch per haul in stratum i and its variance are denoted by \bar{X}_i and s_i^2 respectively, then an unbiased estimate of the population mean \bar{X} is the stratified mean \bar{X}_{st} , which is given by:

$$\bar{X}_{st} = \frac{1}{N} \sum_{i=1}^k N_i \bar{X}_i = \sum_{i=1}^k W_i \bar{X}_i$$

where $W_i = \frac{N_i}{N} = \frac{A_i}{A}$ is the relative size of the ith stratum (A_i is the area of the ith stratum and A is the total area surveyed). The variance of the stratified mean is given by

$$\text{var}(\bar{X}_{st}) = \sum_{i=1}^k W_i^2 \text{var} \bar{X}_i = \sum_{i=1}^k W_i^2 \frac{s_i^2}{n_i}$$

where n_i is number of hauls in the ith stratum and n is the total number of hauls in the survey.

Table 1.1 shows the areas used in the swept-area method to estimate biomass for the different regions. A stratified semi-random design was used with depth and region as stratification factors. Estimated total biomass by species/group was obtained by summing estimates for each depth stratum.

For conversion of catch rates (kg/hour) to fish densities (t/NM²), the effective fishing area was considered as the product of the wing spread and the haul length, or distance over the bottom, as measured by means of the SCANMAR[®] equipment based on GPS readings. The area swept for each haul was thus 18.5 times the distance trawled, raised to NM²/hour. The catchability coefficient (q), i.e the fraction of the fish encountered by the trawl that was actually caught, was conservatively (and for comparison with previous surveys) assumed equal to 1. Mean fish densities by species and strata and the total area surveyed were calculated by the swept-area module in Nansis Maptool.

CHAPTER 3 OCEANOGRAPHIC CONDITIONS

3.1 Surface distribution

The surface layer temperature (5 m depth) were continuously recorded during the cruise. Figure 3.1 shows the horizontal distribution of sea surface temperature (SST) for São Tomé and Príncipe

The SST around Príncipe was relatively high on the northern part of the island with temperatures above 29°C. The temperature decreased gradually to <27°C at the southern side of the island plateau. The temperature is slightly higher than what has been observed previous years but the survey is also 1-2 months earlier in the year than previous surveys and it is difficult to make any direct comparison.

The temperature at São Tomé varied from 28°C off the shelf at the north eastern side of the island to <23°C at the south eastern side over the shelf. The cooler temperature indicating upwelling within that area supported also by increasing salinity and relative fluorescence in the same area. The eastern side showed water temperatures around 26-27°C. A temperature front was observed at the central west coast of the island with temperatures increasing rapidly northwards. There was generally more variability in temperature within the surveyed area than observed previous years.

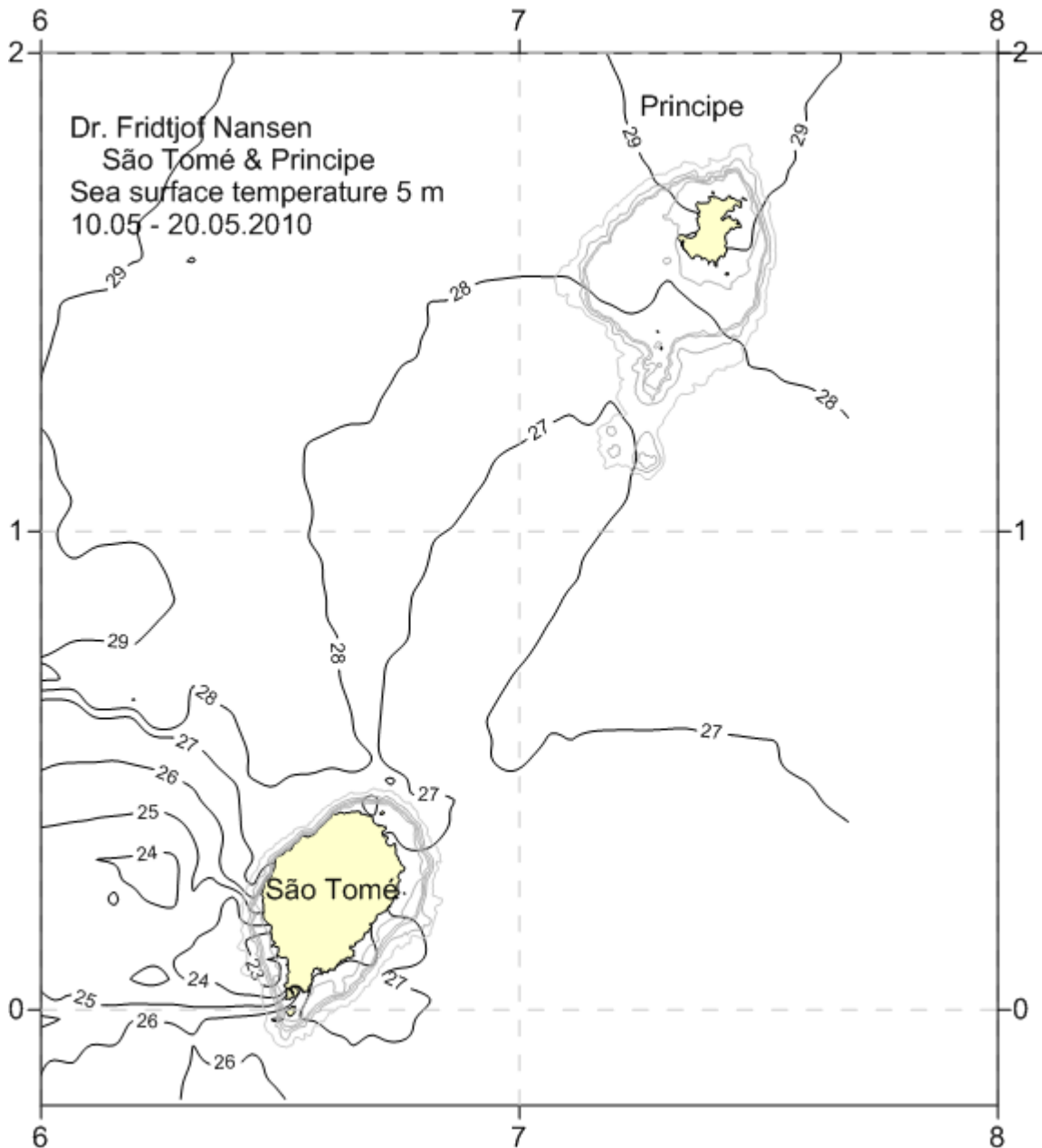


Figure 3.1 Horizontal distribution of surface temperature (5 m depth) off São Tomé and Príncipe

The Sea surface salinity SSS (Figure 3.2) was recorded from the Thermosalinograph at 5 m depth. SSS at Príncipe showed lowest salinity at the northern side of the island (<33.0). A frontal zone was observed south of the island where salinity increased from 33.2 close to the island towards 35.8 at the far south eastern end of the plateau.

Around São Tomé salinity around 35.5 was experienced over most of the eastern and south western side. Salinity above 36.0 was experienced in one area on the far south western side corresponding with cooler temperatures. A strong salinity front was observed at the north western side of the island with salinity decreasing from 35.5 towards 33.5. There were generally more variability in salinity within the investigated area than what has been observed

previous years with both higher minimum and maximum values compared with previous surveys.

The temperature and salinity map indicates two water masses of different origin. Cooler more saline water masses approaching from the south east of São Tomé and warmer water masses corresponding with low salinity waters with the origin in the Gulf of Guinea.

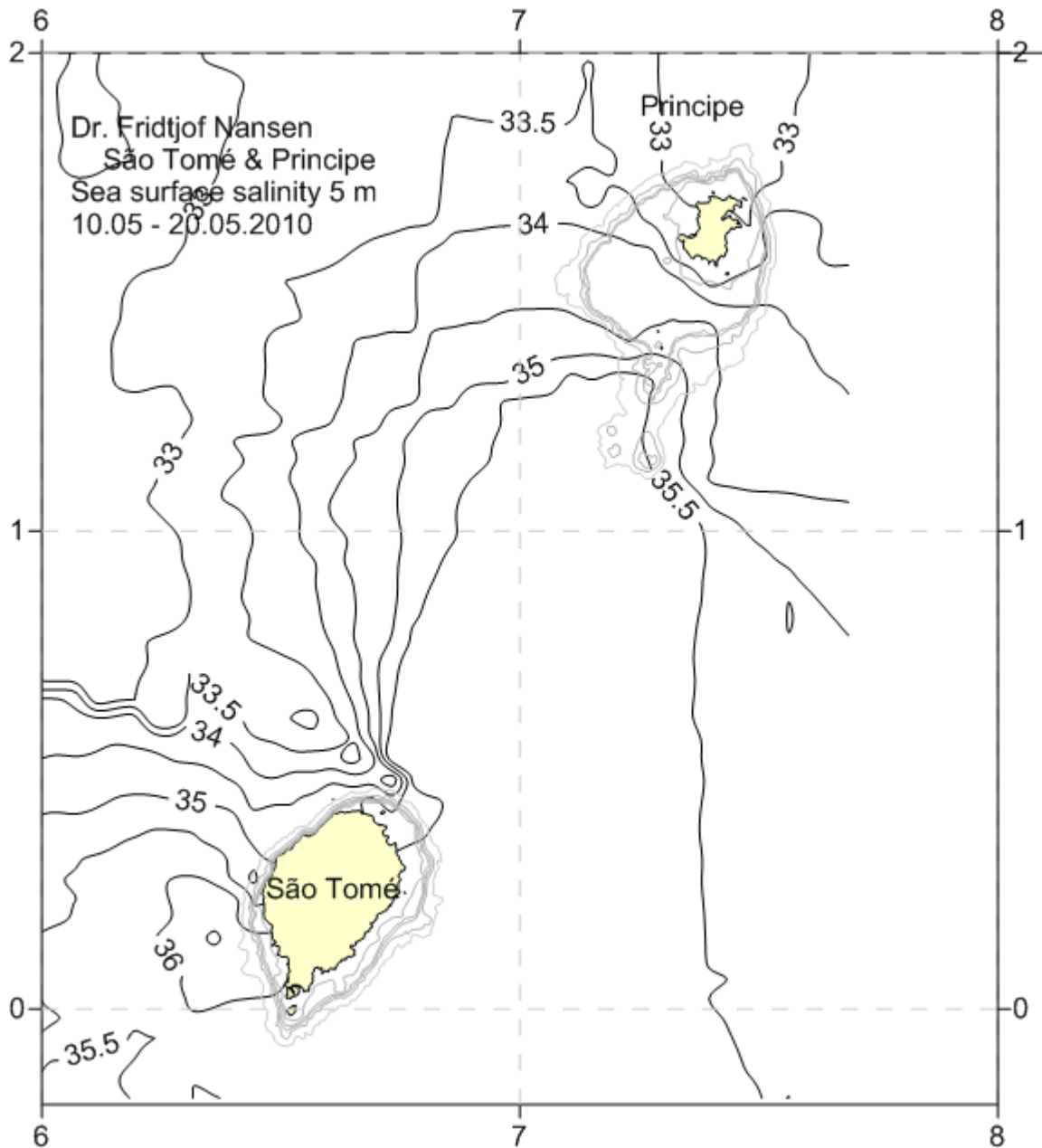


Figure 3.2 Horizontal distribution of surface salinity (5 m depth) in São Tomé and Príncipe

Relative fluorescence was also recorded from the thermosalinograph. Fluorescence is a proxy for chlorophyll in the water and indicate where the production is highest. The surface values observed off Príncipe were low (around 0.01) and gave no indications of upwelling or high production on the shelf. This was also the case around São Tomé with only slightly increasing

chlorophyll values >0.02 at the south western side of the island associated with cooler and more saline water masses indicating upwelling in this area.

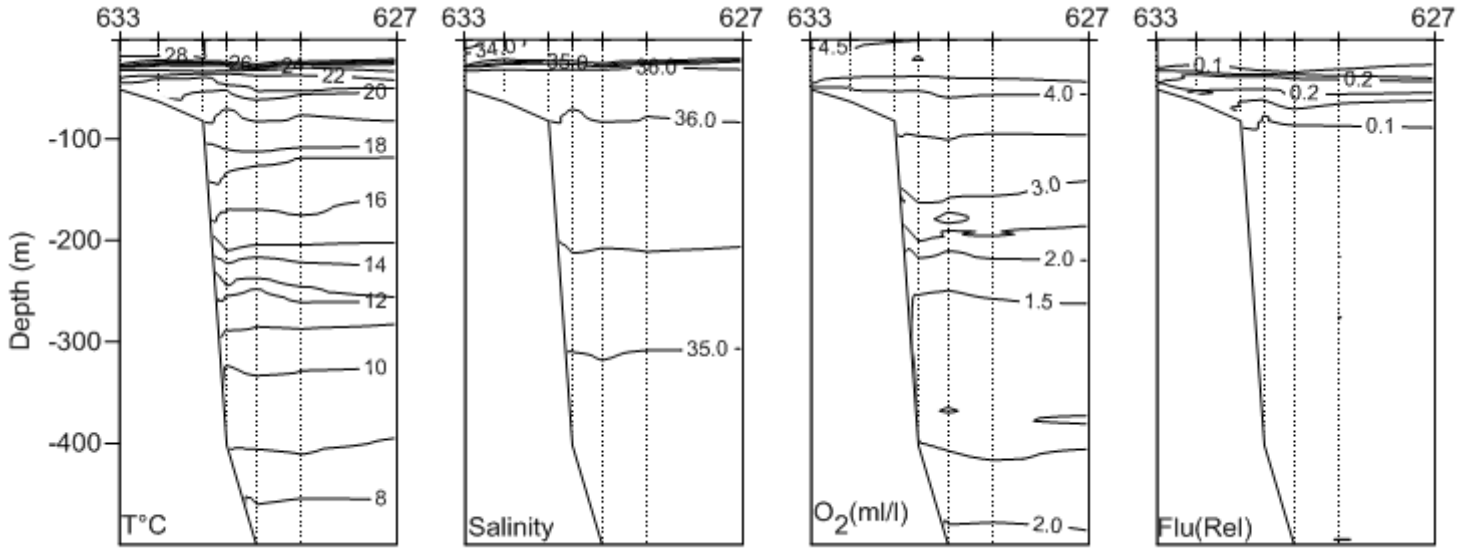
3.2 Vertical sections

Three CTD transects with recorded temperature, salinity, dissolved oxygen and fluorescence were sampled on Príncipe, Figure 3.3. Figure 1.1 show the position of the various CTD transects. Temperature profiles showed stable surface temperature around 28°C in the upper 25 m with a thermocline on the shelf to 50 m depth with temperatures $< 22^{\circ}\text{C}$ below, decreasing to 8°C at 500 m depth. The profiles showed signs of downwelling off the shelf. Salinity profiles showed lowest surface salinity close to the coast (34.0), except for the north eastern transect where the lowest salinity was found offshore (33.5). A salinocline was present at around 25 m depth with salinity increasing from 34.0 to a salinity maximum of 36.0 at on the shelf edge around 80 m depth. The salinity then declined to <35.0 from 300 m depth and deeper. The oxygen profiles showed well oxygenated water with surface values above 4.5 ml/l gradually declining to $< 2\text{ml/l}$ at 500 m depth. Relative fluorescence was also recorded from the CTD. It show that the highest production occurred just below the termocline from about 50 m depth to 100 m depth. Highest production was just off the shelf edge with relative values >0.3 .

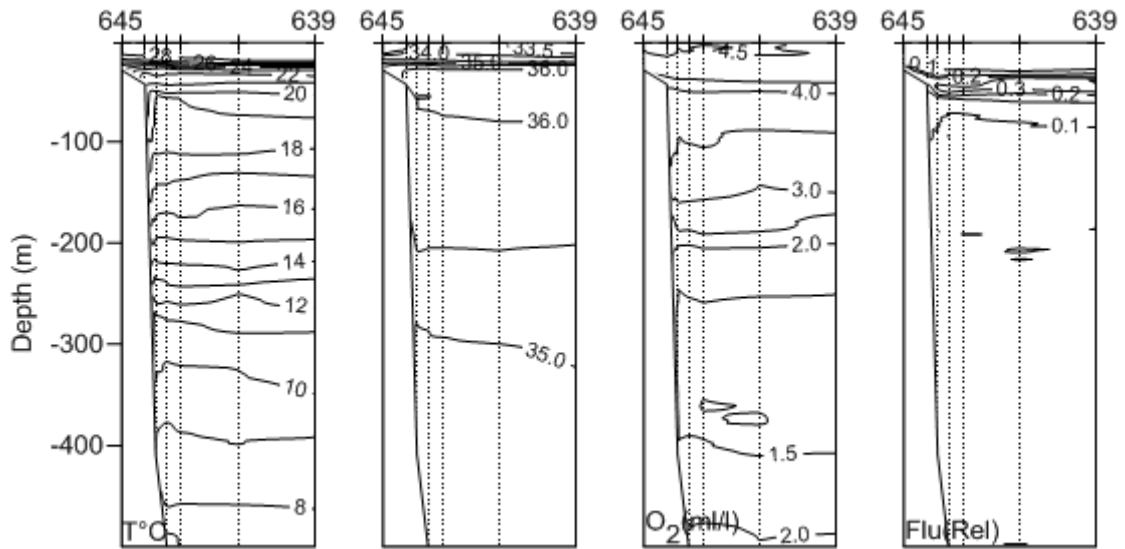
Four CTD transects were taken off São Tomé, three of them are depicted in Figure 3.3. Figure 1.1 show the position of the transects. The São Tomé west transect was taken on the southern side of the frontal zone and show surface temperatures around $23\text{-}24^{\circ}\text{C}$, gradually decreasing to 18°C at 100 m depth and temperatures of 8°C at 500 m depth. The two other transects in the south and north east of São Tomé show surface temperatures above 25°C and a stronger temperature decrease in the upper 50 m. The salinity show surface values >36.0 close to the coast on the west and south transect and 35.5 at the north eastern transect. In deeper waters the salinity decreased gradually towards 35.0 deeper than 300 m. The oxygen values show well oxygenated waters trough the whole water column on all transects with surface values of 4.5 ml/l decreasing to 1.5 ml/l between 250-300 m depth and increasing again in deeper waters. The relative fluorescence show highest primary production in water depths 50-100 m depth on the west and south of the island. The north western transect also shows somewhat higher primary production towards the surface inshore on this transect. Primary production on the east of the island was low with relative fluorescence only one third of values observed on the two other transects.

Comparing the transects off São Tomé and Príncipe one can observe the effect of the warmer and less saline surface waters coming from the Gulf of Guinea having a pronounced effect in the upper 50 m of the water column at the northern most island.

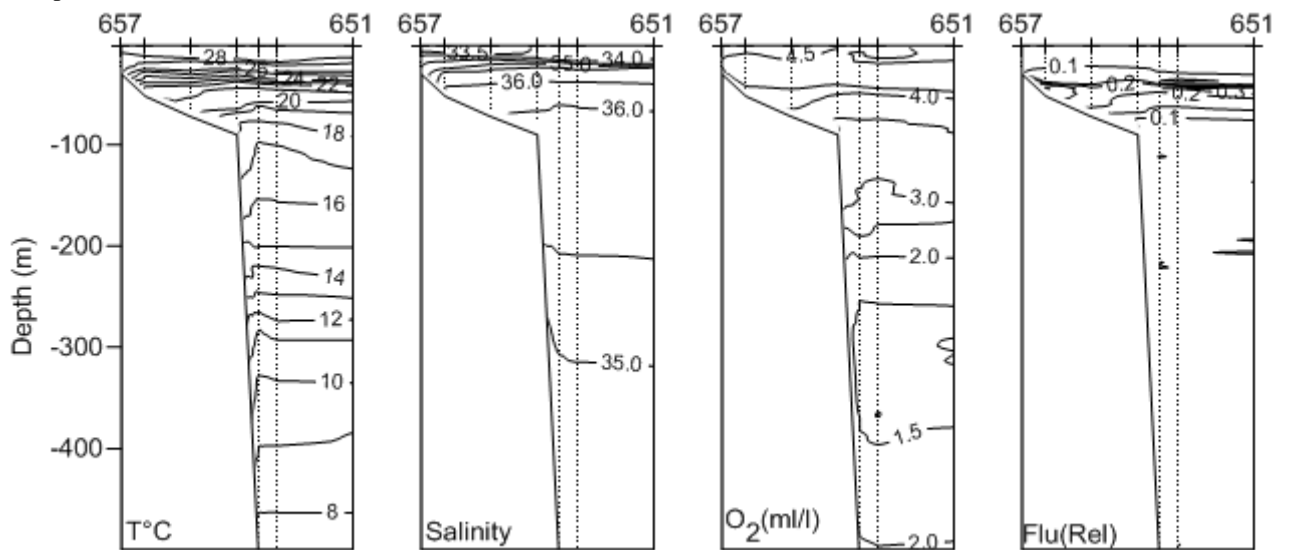
Principe - southeast



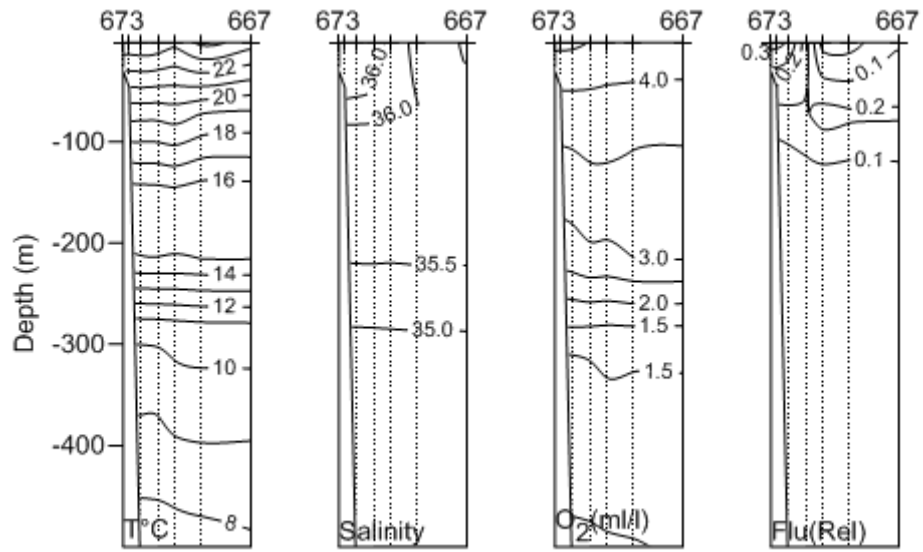
Principe - northeast



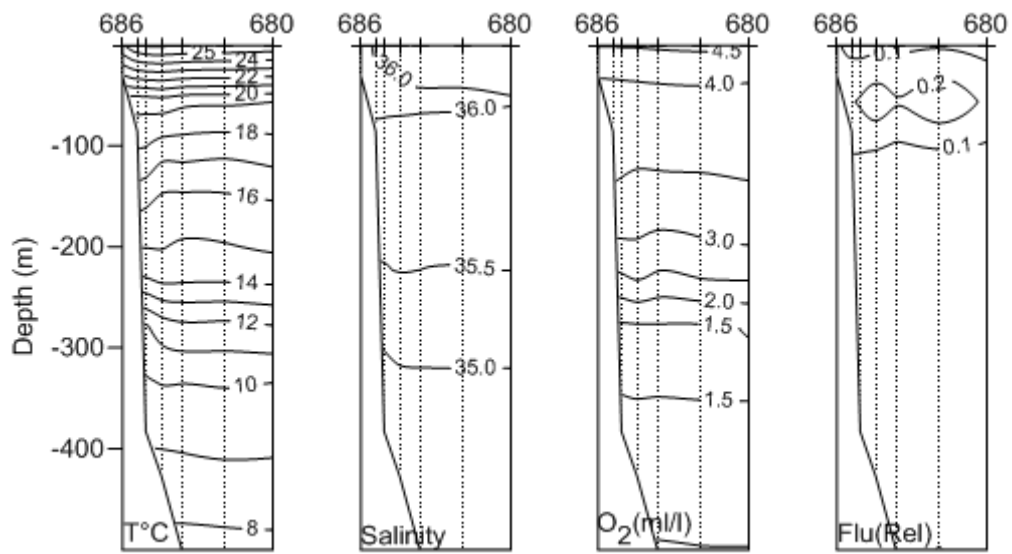
Principe - west



São Tomé - west



São Tomé - south



São Tomé - northeast

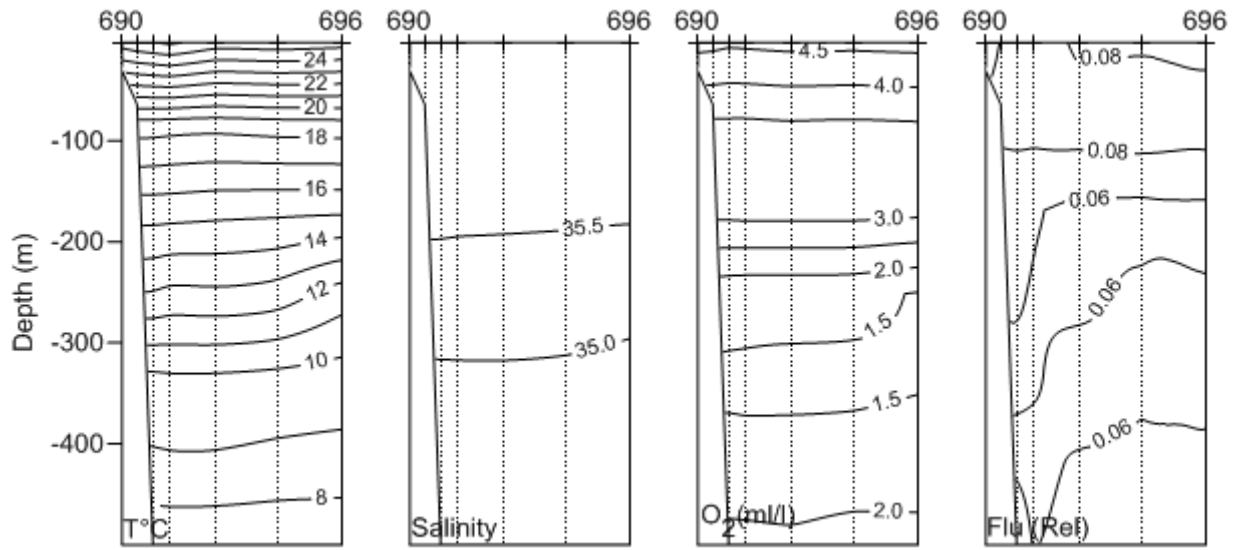


Figure 3.3 Vertical sections of temperature, salinity and oxygen and relative fluorescence at São Tomé and Príncipe; Príncipe - southeast, Príncipe - northeast, Príncipe - west, São Tomé - west, São Tomé - south, and São Tomé - northeast.

CHAPTER 4 RESULTS

4.1 Acoustic observations around São Tomé and Príncipe

The distribution area of main groups of pelagic fish in the region, i.e. sardinellas, PEL 1 (Clupeids), PEL 2 (mainly carangids) and horse mackerel, are recorded with the Simrad ER 60 echosounder. However as during previous years only very few registrations were made of small pelagic species off São Tomé and Príncipe. Some *Sardinella maderensis* and *Sardinella aurita* was caught off São Tomé. However, no estimate of abundance was made for these areas. Pelagic fish, mainly flying fish *Parexocetus brachypterus*, were observed on the surface both during the night and day, but these were not recorded on the echo sounder. There were consistent acoustic recordings of demersal fish over the whole shelf area on both islands, and particularly on the shelf edge and other untrawlable grounds. This indicates that the trawl survey underestimates the abundance of demersal fish on the islands.

4.2 Fish traps

During this survey a few fishing trials was conducted with Norwegian made fish traps (baited and unbaited). The first type was a two chamber foldable cod trap and a double round trap with leading net for lobster. The first setting of 7 traps was made on the eastern side of Príncipe. However all traps were stolen by local fishermen during the night and no results were obtained. The next set of five traps were deployed on the south eastern side of São Tomé on shallow sandy bottom. Soaking time was about 24 h. One *Sepia officinalis* was caught in total. Most of the bait was removed from the traps indicating that small fish had been eating on the bait without been caught. The third set of traps (five in total) was set on the south western side of São Tomé. Soaking time was 24 h. One trap was lost in the strong wave surge, the four others gave no results but all bait was removed. The bait was replaced and the traps reset for another 24 h. this time two more traps was lost in the heavy sea while one trap came up empty and one trap caught one royal spiny lobster (*Panulirus regius*). After this the trap trials was discontinued. The traps seems to be relatively unstable in the heavy surge around São Tomé. They were often moved from their location of deployment and did not seem to be efficient in this environment.

4.3 Results from the trawl survey

The composition of the fish fauna on the continental shelf and slope changes with depth and the catch-distribution analyses were therefore performed for three depth strata on the shelf, 0-50 m (inner shelf) and 51-100 m (outer shelf). The analyses where performed on the following groups; Demersal, pelagic, shrimps, cephalopods, sharks and others. The Demersal group consist of the valuable demersal species groups, Grunts, Groupers, Croakers, Snappers

and Seabreams. For the different analysis the “other” group includes all species not accounted for in any group elsewhere. Therefore, the content of “other” will change from table to table.

The locations of the trawl stations are shown in Figure 1.1. Records of fishing stations and catches are presented in Annex I and pooled length distributions (weighted by catch) of main species by area are shown in Annex II. In the swept-area biomass estimates, only the shelf area down to depths of 100 m was included. Mean densities of the main demersal species by depth strata, occurrence and catch distributions are shown in Annex IV.

Príncipe

A total of 13 swept area trawl stations was carried out on Príncipe, four in depths <50 m and nine between 51 -100 m. The shelf generally is very steep and no trawl stations were possible deeper than this.

The overall catch rate on the inner shelf was 352 kg/h (Table 4.1 a). The most abundant species were found within the group of “other” species. It was particularly the flying gurnard, *Dactylopterus volitans*, that was abundant in the catches, contributing 36% to the overall catch (128 kg/h). Also the small cowfish, *Acanthostracion guinensis*, was very abundant in the catches with 35% and 123 kg/h of the overall catch. Other species were only present in low numbers. Pelagic species, mainly carangids had catch rates of 10.9 kg/h or 3.1% of the overall catch while demersal species, mainly various types of Seabreams had average catch rates of 9.4 kg/h (2.7% of the catch). Cephalopods had catch rates of 5 kg/h while no shrimps or sharks were found.

Deeper than 50 m catch rates decreased considerably to 127 kg/h (Table 4.1 b). The group of “other” species was still the most abundant with *Dactylopterus volitans* as the most abundant species with catches of 50 kg/h and 39% of the overall catch. The group of other species contributed with 46% of the catch and catch rates of 58 kg/h. The catch consisted mainly of seabreams, the red pandora, *Pagellus bellottii*, and bluespotted seabream, *Pagrus caeruleostictus*. Cephalopods comprised 4 % of the catch with catch rates of 5 kg/h. Pelagic species, mainly carangids, comprised 1.1% of the catch and 1.4 kg/h. no shrimps or sharks were found.

Table 4.1 Príncipe. Catch rates (kg/h) of main demersal species grouped by families in swept-area bottom-trawl hauls on the shelf a) 0-50 m, b) 50-100 m

a) 0-50 m

Station	Gear depth	Cephalopods	Demersal	Pelagic	Sharks	Shrimps	Other	Total
3	49.5	8.2	17.8	2.3	0	0	291	319.4
4	31	10.4	2.9	25.9	0	0	586.5	625.6
5	39	1.4	14.1	2.4	0	0	79.9	97.8
12	42.5	0	2.9	12.8	0	0	350.3	366
Mean	40.5	5	9.4	10.9	0	0	326.9	352.2
Std dev	7.7	5.1	7.7	11.2	0	0	208.4	216.6
%		1.4	2.7	3.1	0.0	0.0	92.8	100.0

b) 51-100 m

Station	Gear depth	Cephalopods	Demersal	Pelagic	Sharks	Shrimps	Other	Total
1	59.5	16.9	15.6	6	0	0	3.7	42.1
2	52.5	0.1	7.7	0.5	0	0	4.6	13.1
6	60	6.9	127.1	4.2	0	0	92.7	230.9
7	66	1.5	75.5	0	0	0	30.1	107.2
8	80.5	2.6	193.2	0	0	0	20.7	216.5
9	89.5	2.4	18.9	1.3	0	0	18.8	41.4
10	73.5	5.8	35.1	0.5	0	0	58.5	99.9
13	86	7.2	36.8	0	0	0	14.2	58.2
14	64	2.8	13.1	0	0	0	315.9	331.8
Mean	70.2	5.1	58.1	1.4	0	0	62.1	126.8
Std dev	12.9	5.0	63.5	2.2	0.0	0.0	99.4	108.5
%		4.0	45.8	1.1	0.0	0.0	49.0	100.0

São Tomé

A total of eight swept area trawl stations was carried out off São Tomé, two in depths <50 m and six between 51 -100 m (Table 4.2). The shelf is generally very steep around the island and no trawl stations were possible deeper than this. Since only two trawls were possible more shallow than 50 m the catch rates was summarized for the whole region from 0-100 m as one.

The overall catch rate was 462 kg/h. The most abundant species were within the group of "other" which contributed to 48% of the overall catch. It was particularly the flying gurnard, *Dactylopterus volitans*, that was abundant in the catches contributing 27% to the overall catch (126 kg/h) and lesser African threadfin, *Galeoides decadactylus*, who contributed 25 kg/h or 5% of the total. The second most important group was the valuable demersal species that contributed with average catch rates of 199 kg/h or 43% of the overall. The most common species in this group was the golden snapper, *Lutjanus fulgens*, with average catches of 93 kg/h or 20% of the total, and the red pandora *Pagellus bellottii* who contributed 53 kg/h or 11% of the total. Pelagic species, mainly carangids contributed with catch rates of 31 kg/h or

7% of the total while Cephalopods had catch rates of 11 kg/h, ~2% of the total. Sharks and shrimps were not important in the catches.

Table 4.2 São Tomé. Catch rates (kg/h) of main demersal species grouped by families in swept-area bottom-trawl hauls on the shelf a) 0-50 m, b) 50-100 m

Station	Gear depth	Cephalopods	Demersal	Pelagic	Sharks	Shrimps	Other	Total
18	73	0.8	143.6	2.6	0	0	46.9	194
19	44.5	6.5	48.7	1.4	0	0	193.5	250.1
20	69	18.2	49.1	115.7	0	0	212.4	395.4
21	25	6.5	6.3	78.9	0	0	480.2	571.9
22	68.5	1.3	46.3	10.5	0	0	57.5	115.5
25	61	12.9	311.9	5.1	0	0.1	101.8	431.8
26	57.5	18.4	870.4	21.7	0	0	394.2	1304.8
27	67	21.5	117	9.1	0	0	284.4	431.9
Mean	58.2	10.7	199.2	30.6	0	0	221.4	461.9
Std dev	16.1	8.1	287.6	42.8	0	0.1	157.3	371.4
% Catch		2.3	43.1	6.6	0.0	0.0	47.9	100.0

4.4 Biodiversity

Of the 41 trawl stations occupied during the survey, 35 were with a bottom trawl and six with a pelagic trawl. Shelf depths fished with the bottom trawl varied from 26 to 94 m, while those with the pelagic trawl were over the continental slope over bottom depths varying from around 300 m to almost 1100 m. The pelagic trawl was rigged with buoys attached to the headrope, so as to fish from the surface to no deeper than about 10 m below the surface; it was deployed only during the night and captured mostly vertically-migrating species.

Table 4.3 lists the 514 specimens of fishes representing more than 145 species that were collected off São Tomé and Príncipe during the survey. These specimens will be deposited in the California Academy of Sciences research collection of fishes. The list is not all-inclusive in that some species captured in the trawls were not saved for one reason or another. Proper identifications of many specimens still await further examination and a thorough check of the literature; these unidentified specimens may add to the total number of species represented. This holds particularly true for the near-surface collections made at night with the pelagic trawl: mid-water and juvenile fishes, which are often difficult to identify, dominated these catches. Of the 145+ species collected, more than 50 represent species that have not been recorded previously from São Tomé and Príncipe (these species are noted with an asterisk following their names); a few may represent undescribed species. Table 4.4 lists the 118 species of fishes (and one invertebrate) from which tissue samples were taken for DNA analysis; most of these samples will be deposited in the University of Kansas tissue collection, but others will be sent to specialists on their request. The tag numbers in the table refer to the

numbered vials in which tissue from the specimens are stored (in 95% ethyl alcohol). The number is also written on the tie tags attached to the particular specimen. Although a comprehensive collection of invertebrates would have been desirable, the interests of the collector and the constraints imposed on bulk and weight by carrying the specimens as airline luggage precluded such collections. Thus, only 31 specimens representing 21 invertebrate species and one alga were retained for deposit at the California Academy of Sciences.

Table 4.3 lists of the specimens of fishes that were collected off São Tomé and Príncipe during the survey.

	Family	Species name	Sta. No.	#saved
1	Acanthuridae	<i>Acanthurus monroviae</i>	15,26,28	2
2	Acropomatidae	<i>Synagrops bellus*</i>	33,34,35	4
3	Albulidae	<i>Albula vulpes</i>	12	1
4	Anguilliformes	<i>leptocephalus</i>	15,16	41
5	Antennariidae	<i>Antennarius pardalis</i>	25	1
6	Antennariidae	<i>Antennarius sp</i>	32	1
7	Anthiidae	<i>Anthias anthias</i>	6	1
8	Apogonidae	<i>Apogon canariensis*</i>	34,35	4
9	Apogonidae	<i>Apogon sp. A*</i>	11,15,18,32	18
10	Apogonidae	<i>Apogon sp. B*</i>	33	6
11	Ariommidae	<i>Ariomma bondi*</i>	8,13	3
12	Astronesthidae	<i>genus*</i>	17	2
13	Aulostomidae	<i>Aulostomus strigulus</i>	2	1
14	Balistidae	<i>Balistes capricus</i>	3	1
15	Balistidae	<i>Balistes punctatus</i>	3	1
16	Bothidae	<i>Arnoglossus imperialis*</i>	20	4
17	Bothidae	<i>bothid larvae</i>	11,15	34
18	Bothidae	<i>Bothus guibei</i>	5,12	2
19	Bothidae	<i>Bothus podas*</i>	21,33	2
20	Bothidae	<i>Citula ligulatula</i>	20	1
21	Bramidae	<i>Taractes</i>	17	1
22	Bregmacerotidae	<i>Bregmaceros sp</i>	23	2
23	Carangidae	<i>Carangoides bartholomaei</i>	12	2
24	Carangidae	<i>Caranx crysos</i>	12	1
25	Carangidae	<i>Decapterus macarellus</i>	4	1
26	Carangidae	<i>Decapterus punctatus</i>	2,19	2
27	Carangidae	<i>Selar crumenophthalmus</i>	4	1
28	Carangidae	<i>Selene dorsalis</i>	22,28	8
30	Carangidae	<i>Seriola carpenteri</i>	3,18	2
32	Carangidae	<i>Seriola rivoliana</i>	6	1
33	Carangidae	<i>Uraspis secunda</i>	36	1
34	Carapidae	<i>Carapus acus*</i>	13	1
35	Cepolidae	<i>Cepola sp</i>	30,33	3
36	Ceratiidae	<i>Cryptosaras couesi*</i>	17	1
37	Chaetodontidae	<i>Chaetodon hoefleri</i>	26	1
38	Chaetodontidae	<i>Prognathodes marcellae</i>	18	1
39	Clupeidae	<i>Sardinella aurita</i>	25	1
40	Clupeidae	<i>Sardinella maderensis</i>	16	1
41	Congridae	<i>Ariosoma sp*</i>	27	1
42	Congridae	<i>Conger eel*</i>	30	2
43	Congridae	<i>Uroconger?*</i>	32,35	3
44	Dactylopteridae	<i>Dactylopterus volitans</i>	3,5,34	1
45	Diodontidae	<i>Chilomycterus spinosus mauretanicus*</i>	2	1
46	Diodontidae	<i>Diodon holocanthus</i>	1	1
47	Drepanidae	<i>Drepane africana</i>	12	1
48	Ephippidae	<i>Ephippus goreensis</i>	37	1
49	Exocoetidae	<i>Cypselurus cyanopterus*</i>	15	1
50	Exocoetidae	<i>Hirundichthys affinis*</i>	11	1
51	Fistulariidae	<i>Fistularia petimba*</i>	28	4
52	Gempylidae	<i>Neolotes tripes?*</i>	11,15,17,24	6
53	Gempylidae	<i>Nesiarchus nasutus*</i>	17	0
54	Gempylidae	<i>Notoscopelus sp*</i>	24	1
55	Gempylidae	<i>Promethichthys prometheus*</i>	35	0
56	Gempylidae	<i>short body*</i>	17	1
57	Gobiidae	<i>goby unident w/fine blk vertical lines*</i>	33	1
58	Gobiidae	<i>Leseurogobius?*</i>	22,25,30,32,40	9
59	Gobiidae	<i>Thorogobius angolensis?*</i>	30,34,35,40	10
60	Gonostomatidae	<i>gonostomatid larva?*</i>	16	5
61	Gonostomatidae	<i>Howella sp*</i>	17	1
62	Haemulidae	<i>Pomadasys incisus</i>	23	1
63	Haemulidae	<i>Pomadasys rogeri</i>	23	1
64	Hemiramphidae	<i>Hemiramphid larvae</i>	15	2
65	Holocentridae	<i>Holocentrid larvae</i>	15	1
66	Labridae	<i>Bodianus speciosus</i>	7	1
67	Labridae	<i>Labrid larva?</i>	16	1
68	Labridae	<i>Xyrichtys novacula</i>	21	1
69	Lethrinidae	<i>Lethrinus atlanticus</i>	2	1
70	Lophotidae	<i>Eumecichthys fiski*</i>	17	1
71	Lutjanidae	<i>Apsilus fuscus</i>	23,26,28,32	5
72	Lutjanidae	<i>Lutjanus fulgens</i>	6	1
73	Lutjanidae	<i>Lutjanus goreensis</i>	12	1
74	Malacosteidae	<i>Malacosteus sp*</i>	17	2

75	Monacanthidae	<i>Alutera heudeloti(?)*</i>	5	1
76	Monacanthidae	<i>Alutera monoceros*</i>	30	1
		<i>São Tomé and Príncipe hanolepis</i>		
77	Monacanthidae	<i>hispidus</i>	4	1
78	Moridae	<i>Gadella imberbis*</i>	33	1
79	Moridae	<i>Physiculus cyanostrophus*</i>	33,34	4
80	Moridae	<i>Physiculus sp A*</i>	32,33,34,35	11
81	Mullidae	<i>Pseudupeneus prayensis</i>	5,16	2
82	Muraenidae	<i>Muraena melanotis</i>	26	1
83	Myctophidae	<i>myctophid denuded large*</i>	15,17	12
84	Myctophidae	<i>myctophid silvery*</i>	15	17
85	Myctophidae	<i>myctophid small*</i>	15,17	43
86	Myctophidae	<i>Myctophids*</i>	24,32,33	27
87	Nemichthyidae	<i>Nemichthys curvirostris*</i>	17	1
88	Nettasomatidae	<i>Nettasoma sp?*</i>	32	2
89	Nomeidae	<i>Cubiceps pauciradiatus*</i>	11,15,17	6
90	Nomeidae	<i>Cubiceps sp A*</i>	17,32,33,34,35	13
91	Notoscopelidae	<i>Notoscopelus sp*</i>	17	1
92	Ophichthidae	<i>Echelus myrus*</i>	23	1
93	Ophichthidae	<i>Ophichthis ophis</i>	33	1
94	Ophidiidae	<i>Brotula barbata*</i>		1
95	Ophidiidae	<i>Ophidion lozanoi?*</i>	33	7
96	Ostraciidae	<i>Acanthostracion guineensis</i>	3	1
97	Paralepididae	<i>Lestidiops?*</i>	34	2
98	Paralichthyidae	<i>Citharus linguatula*</i>		1
99	Paralichthyidae	<i>Syacium guineensis</i>	7,19	2
100	Platycephalidae	<i>Grammoplites gruvelli*</i>	19,22	2
101	Polynemidae	<i>Galeoides decadactylus</i>	22	1
102	Priacanthidae	<i>Priacanthus arenatus</i>	10,30,32	4
103	Psettodidae	<i>Psettodes belcheri*</i>	3	1
104	Rajidae	<i>Raja miraletus*</i>	10	1
105	Sciaenidae	<i>Pseudotolithus senegalensis</i>	30	1
106	Sciaenidae	<i>Umbrina canariensis*</i>		1
107	Scombridae	<i>Euthynnus alletteratus</i>	16	1
108	Scombridae	<i>Scombrid larvae</i>	15	8
109	Scorpaenidae	<i>Scorpaena laevis</i>	21,30	2
		<i>Scorpaena São Tomé and Príncipe</i>		
110	Scorpaenidae	<i>hanica*</i>	22	1
111	Serranidae	<i>Epinephelus goreensis</i>	23	0
112	Serranidae	<i>Epinephelus aeneus</i>	25	1
113	Serranidae	<i>Paranthias furcifer</i>	6,18	2
114	Serranidae	<i>Rypticus saponaceus</i>	1	1
115	Serranidae	<i>Serranus accraensis*</i>	26	1
116	Serranidae	<i>Serranus n.sp. Heemstra</i>	21,30,32	3
117	Soleidae	<i>Dicologlossus sp</i>	23	1
118	Soleidae	<i>Microchirus frechkopi*</i>	26,30	2
119	Soleidae	<i>Microchirus hexophthalmus*</i>	33	2
120	Sparidae	<i>Boops boops</i>	32	2
121	Sparidae	<i>Brachydeuterus auritus</i>	19	1
122	Sparidae	<i>Dentex canariensis*</i>		1
123	Sparidae	<i>Dentex congoensis</i>	1	1
124	Sparidae	<i>Pagellus bellottii</i>	1	1
125	Sparidae	<i>Pagrus caeruleostictus</i>	1,19,25,26	4
126	Sphyraenidae	<i>Sphyraena guachancho</i>	4	1
127	Sphyraenidae	<i>Sphyraena sphyraena*</i>		1
128	Stomiidae	<i>Eustomias?*</i>	33	1
129	Stomiidae	<i>Stomias?*</i>	17	3
130	Synodontidae	<i>Saurida brasiliensis*</i>	17,30	4
131	Synodontidae	<i>synodontid larva</i>	11,16	38
132	Synodontidae	<i>Trachinocephalus myops</i>	10	1
133	Tetraodontidae	<i>Canthigaster rostrata*</i>	26	1
134	Tetraodontidae	<i>Lagocephalus laevigatus</i>	22	1
135	Tetraodontidae	<i>Lagocephalus lagocephalus</i>		4
136	Tetraodontidae	<i>Sphoeroides pachygaster*</i>	9	1
137	Tetraodontidae	<i>Tetraodontid larva</i>	28	1
138	Torpedinidae	<i>Torpedo torpedo(spp.?)</i>	4,6,7,8,32	7
139	Trachinidae	<i>Trachinus armatus</i>		1
140	Trachinidae	<i>Trachinus radiatus</i>	6,9	2
141	Triglidae	<i>Cheilodonicthys gabonensis*</i>	19	1
142	Triglidae	<i>Cheilodonicthys lastoviza*</i>	10	3
143	Triglidae	<i>Lepidotrigla carolae*</i>	7,33,34,35	4
144	Uranoscopidae	<i>Uranoscopus polli</i>	10	1
145	Zeidae	<i>Zeus faber*</i>	9	1

TOTAL FISHES**514**

Table 4.4 lists of the species of fishes (and one invertebrate) from which tissue samples were taken for DNA analysis

Tissue samples only	São Tomé et Príncipe – DFN Survey 2010-04-05	Station	Tissue #saved	Tissue vial #
Family	Species name			
Serranidae	<i>Rypticus saponaceus</i>	1	1	1
Diodontidae	<i>Diodon holocanthus</i>	1	1	2
Sparidae	<i>Dentex congoensis</i>	1	1	3
Aulostomidae	<i>Aulostomus strigulus</i>	2	1	4
Sparidae	<i>Pagellus bellottii</i>	1	1	5
Sparidae	<i>Pagrus caeruleostictus</i>	1	1	6
Diodontidae	<i>Chilomycterus spinosus</i>	2	1	7
Carangidae	<i>Decapterus punctatus</i>	2	1	8
Dactylopteridae	<i>Dactylopterus volitans</i>	3	1	9
Lethrinidae	<i>Lethrinus atlanticus</i>	2	1	10
Balistidae	<i>Balistes punctatus</i>	3	1	11
Balistidae	<i>Balistes capricus</i>	3	1	12
Ostraciidae	<i>Acanthostracion quadricornis</i>	3	1	13
Psettodidae	<i>Psettodes belcheri</i>	3	1	14
Carangidae	<i>Seriola carpenteri</i>	3	1	15
Torpedinidae	<i>Torpedo torpedo(?)</i>	4	1	16
Sphyrnidae	<i>Sphyrna sphyraena</i>	4	1	17
Carangidae	<i>Decapterus macarellus</i>	4	1	18
Carangidae	<i>Selar crumenophthalmus</i>	4	1	19
Monacanthidae	<i>São Tomé and Príncipe hanolepis hispidus</i>	4	1	20
Dactylopteridae	<i>Dactylopterus volitans</i>	5	1	21
Bothidae	<i>Bothus guibeii</i>	5	1	22
Mullidae	<i>Pseudupeneus prayensis</i>	5	1	23
Monacanthidae	<i>Alutera heudeloti</i>	5	1	24
Lutjanidae	<i>Lutjanus fulgens</i>	6	1	25
Serranidae	<i>Paranthias furcifer</i>	6	1	26
Trachinidae	<i>Trachinus radiatus</i>	6	1	27
Anthiidae	<i>Anthias anthias</i>	6	1	28
Carangidae	<i>Seriola rivoliana</i>	6	1	29
Torpedinidae	<i>Torpedo torpedo(?)</i>	6	1	30
Labridae	<i>Bodianus speciosus</i>	7	1	31
Torpedinidae	<i>Torpedo torpedo(?)</i>	7	1	35
Triglidae	<i>Lepidotrigla carolae</i>	7	1	33
Paralichthyidae	<i>Syacium micrurum</i>	7	1	34
Torpedinidae	<i>Torpedo torpedo(?)</i>	7	1	32
Ariommidae	<i>Ariomma bondi</i>	8	1	36
Trachinidae	<i>Trachinus radiatus</i>	9	1	37
Zeidae	<i>Zeus faber</i>	9	1	38
Tetraodontidae	<i>Sphoeroides pachygaster</i>	9	1	39
Torpedinidae	<i>Torpedo torpedo(?)</i>	9	1	40
Priacanthidae	<i>Priacanthus arenatus</i>	10	1	41
Triglidae	<i>Cheilodonicichthys lastoviza</i>	10	1	42
Synodontidae	<i>Trachinocephalus myops</i>	10	1	43
Rajidae	<i>Raja miraletus</i>	10	1	44
Uranoscopidae	<i>Uranoscopus polli</i>	10	1	45
Synodontidae	<i>synodontid larva</i>	11	1	46
Synodontidae	<i>synodontid larva</i>	11	1	47
Nomeidae	<i>Cubiceps pauciradiatus</i>	11	2	48,51
Gempylidae	<i>Nolotes tripes</i>	11	2	49,52
Exocoetidae	<i>Hirundichthys affinis</i>	11	1	50
Drepanidae	<i>Drepane africana</i>	12	1	53
Bothidae	<i>Bothus guibeii</i>	12	1	54
Carangidae	<i>Caranx crysos</i>	12	1	55
Lutjanidae	<i>Lutjanus goreensis</i>	12	1	56
Albulidae	<i>Albula vulpes</i>	12	1	57
Carangidae	<i>Carangoides bartholomaei</i>	12	1	58
Carapidae	<i>Carapus acus</i>	13	1	60
Exocoetidae	<i>Cypselurus cyanopterus</i>	15	1	61
Myctophidae	<i>myctophid silvery</i>	15	2	62,63
Myctophidae	<i>myctophid denuded large</i>	15	2	64,65
Myctophidae	<i>myctophid small</i>	15	2	66,67
Mullidae	<i>Mullid juvenile</i>	16	1	68
Scombridae	<i>Euthynnus alletteratus</i>	16	1	69
Clupeidae	<i>Sardinella maderensis</i>	16	2	70,71
Carangidae	<i>Seriola carpenteri</i>	18	1	72
Serranidae	<i>Paranthias furcifer</i>	18	1	73
Chaetodontidae	<i>Chaetodon marcellae</i>	18	1	74

Platycephalidae	<i>Grammoplites gruveli</i>	19	1	75
Triglidae	<i>Cheilodonicichthys gabonensis</i>	19	1	76
Sparidae	<i>Brachydeuterus auritus</i>	19	1	77
Bothidae	<i>Arnoglossus imperialis</i>	20	2	78,80
Bothidae	<i>Citula ligulatula</i>	20	1	79
Myctophidae	<i>myctophid denuded large</i>	17	1	81
Gempylidae	<i>short body</i>	17	1	82
Myctophidae	<i>myctophid small</i>	17	1	83
Nomeidae	<i>Cubiceps sp A</i>	17	1	84
Notoscopelidae	<i>Notoscopelus sp</i>	17	1	85
Gonostomatidae	<i>Howella sp</i>	17	1	86
Bramidae	<i>Taractes</i>	17	1	87
Astronesthidae	<i>genus</i>	17	1	88
Malacosteidae	<i>Malacosteus sp</i>	17	1	89
Serranidae	<i>Serranus n.sp. Heemstra</i>	21	1	90
Labridae	<i>Xyrichtys novacula</i>	21	1	91
Bothidae	<i>Bothus podas</i>	21	1	92
Scorpaenidae	<i>Scorpaena laevis</i>	21	1	93
Polynemidae	<i>Galeoides decadactylus</i>	22	1	94
Gobiidae	<i>Gobiid</i>	22	1	95
Carangidae	<i>Selene dorsalis</i>	22	1	96
Tetraodontidae	<i>Lagocephalus laevigatus</i>	22	1	97
Haemulidae	<i>Pomadasyr rogeri</i>	23	1	98
Haemulidae	<i>Pomadasyr incisus</i>	23	1	99
Serranidae	<i>Epinephelus goreensis</i>	23	1	100
Bregmacerotidae	<i>Bregmaceros sp</i>	23		101
Synodontidae	<i>Saurida brasiliensis</i>	17	1	102
Ophichthidae	<i>Echelus myrus</i>	23	1	103
Soleidae	<i>Dicologlossus sp</i>	23	1	104
Gempylidae	<i>Notoscopelus sp</i>	24	1	105
Gempylidae	<i>Neolotes tripes?</i>	24	1	106
Lophotidae	<i>Eumecichthys fiski</i>	17	1	107
Sparidae	<i>Pagrus caeruleostictus</i>	25	1	108
Antennariidae	<i>Antennarius pardalis</i>	25	1	109
Clupeidae	<i>Sardinella aurita</i>	25	1	110
Gobiidae	<i>Leseurogobius</i>	25	1	111
Serranidae	<i>Epinephelus aeneus</i>	25	1	112
Serranidae	<i>Serranus accraensis</i>	26	1	113
Tetraodontidae	<i>Canthigaster rostrata</i>	26	1	114
Chaetodontidae	<i>Chaetodon hoeferi</i>	26	1	115
Soleidae	<i>Microchirus frechkopi</i>	26	1	116
Muraenidae	<i>Muraena melanotis</i>	26	1	117
Lutjanidae	<i>Apsilus fuscus</i>	26	1	118
Acanthuridae	<i>Acanthurus monroviae</i>	26	1	119
Congridae	<i>Ariosoma sp</i>	27	1	120
Sciaenidae	<i>Pseudotolithus senegalensis</i>	30	1	121
Cepolidae	<i>Cepola sp</i>	30	1	122
Monacanthidae	<i>Alutera monoceros</i>	30	1	123
Gobiidae	<i>Thorogobius?</i>	30	2	124,125
Congridae	<i>Conger eel</i>	30	1	126
Sparidae	<i>Boops boops</i>	32	1	127
Nomeidae	<i>Cubiceps sp A</i>	32	1	128
Apogonidae	<i>Apogon sp. A</i>	32	1	129
Moridae	<i>Physiculus sp A</i>	32		130
Tetraodontidae	<i>Lagocephalus juv.</i>	32		131
Antennariidae	<i>Antennarius sp</i>	32		132
Carangidae	<i>Uraspis secunda</i>	36		133
Ephippidae	<i>Chaetodipterus goreensis</i>	37		134
Moridae	<i>Physiculus sp A</i>	33		135
Apogonidae	<i>Apogon sp. B</i>	33		136
Soleidae	<i>Microchirus hexophthalmus</i>	33		137
Ophidiidae	<i>Ophidion lozanoi?</i>	33		138
Moridae	<i>Gadella imberbis</i>	33		139
Acropomatidae	<i>Hypoclydonia bella</i>	33		140
Nomeidae	<i>Cubiceps sp A</i>	33		141
Ophichthidae	<i>Ophichthys ophis</i>	33		142
Stomiidae	<i>Eustomias?</i>	33		143
Opisthobranchia	<i>Nudibranch</i>	2	1	

Although the list of species collected by *Dr. Fridtjof Nansen* is extensive, many species that are more commonly found closer inshore or in cryptic habitats that the vessel was unable to

sample were not obtained. The bottom topography also precluded sampling in many areas that may be found eventually to harbor a rich ichthyofauna. Almost certainly, sampling of the rugged slope areas around the islands would have added many more species to the total, but other methods must be used to properly sample those areas. Comparisons of the catches made during the previous four surveys with those of the current survey also revealed a substantial number of species that were not collected this year. This may reflect a random distribution of species in space and time, rare species (and therefore few individuals available to the trawl), or simply misidentifications. It is obvious from these collections that much of the marine fauna of the islands has yet to be discovered and documented. This is particularly the case with species that live in habitats that have not been adequately surveyed and for those smaller, cryptic species that are difficult to collect by usual fishery methods. In that regard, the collections and observations by scuba divers suggest the possible presence of many yet-to-be-discovered species.

The collection of voucher specimens from which identifications can be checked subsequent to the surveys would have been immensely useful, but such collections were not made until the current survey. Photographs of specimens with accompanying identifications applied during each survey would also be of considerable help in verifying the identifications made and in part substitute for the collection of voucher specimens. In a few instances, such photographic documentation was done by one of us (O. Alvheim) on previous surveys. Re-identifications by photographs and specimens would allow retroactive corrections of identifications from past surveys and permit more accurate and cogent comparisons of year-by-year catches.

As a comparison to the present findings Pedro Afonso et al. in 1999 (*Arquipélago Life and Marine Sciences* 17A:65-92) recorded a total of 124 species of fishes in 108 genera and 61 families from São Tomé and Príncipe. In a more-recent publication by Peter Wirtz et al. (2007; *Zootaxa* 1523:1-48) an updated list of the coastal fishes included 234 fish species, of which 59 constituted new records and 10 species new to science; the authors also listed nine species as endemic to the islands. Considering the vagility of marine fishes, particularly in their early life stages when they are part of the zooplankton fauna and subjected to oceanic currents, the relatively low endemism is perhaps not surprising. The origins of the fish fauna are various, and the relative proximity to the African continent undoubtedly played a dominant role in the development of the marine fauna of São Tomé and Príncipe. However, Wirtz (2001, 2003, 2004) has cited the presence of amphi-Atlantic species of marine invertebrates and fishes as compelling evidence of New World sources for at least part of the fauna. Prevailing surface currents in the region lend support for this argument, although it is known that the islands of São Tomé and Príncipe are sometimes each under very different hydrographic regimes, as observed during this year's survey. Currents can vary considerably and display complex patterns, as the large equatorial currents strike the continent along the Gulf of Guinea and intermix with other currents, including the subequatorial counter-current, and water masses developed to the north and south of the equator. Seasonal shifts of water from the south displacing the water masses originating in the north are a normal condition.

4.5 Review of results

São Tomé and Príncipe are volcanic islands approximately 200 km from the coast of the mainland of Africa, and as such are characterised by an oceanic environment with higher salinity and lower temperatures than along the mainland of Gulf of Guinea. Also the bottom topography and substrate differs greatly from that on the mainland. The coast is rocky and very steep, with a shelf break on both islands around 80 – 100 m depth and bottom depths typically >1000 m off the shelf. The shelf is relatively flat and hard with patches of corral and stones and with sandy substrate in between. Demersal species dominates around the islands, but also pelagic species, carangids, and some few sardinella are found. The biomass estimate for São Tomé and Príncipe was only calculated for the area between 0 – 100 m depth, because trawling was not possible off the shelf break, additionally, due to the nature of the topography on the islands the trawl survey did not cover a fully representative part of the shelf. The biomass estimates presented here must therefore be looked upon as indexes only and not a trough reflection of the actual biomass or a reflection of the total biodiversity. However, the trend in biomass may still be reliable. The biomass estimates are presented in Table 4.3 for selected species groups only. Generally, the biomass estimated on these islands may seem low due to the small shelf area investigated. If one rather looks at catch rates of demersal species like seabreams, gurnards and snappers one observe that these are relatively higher reflecting a relatively high abundance of these species. The fish resources on the island support an important artisanal fishery employing 20% of the nations workforce, and large changes in fish biomass will have huge consequences on the islands.

The abundance of selected species groups on São Tomé was the highest recorded during the surveys with Dr. Fridtjof Nansen since 2004. The overall biomass for these groups were about 1 000 tonnes. The abundance has been relatively stable around 800 tonnes during the previous surveys. Looking at Príncipe the abundance was the lowest during the whole time series with 500 tonnes. In 2007 the biomass was estimated at 2 000 tonnes while in 2006 1000 tonnes was estimated within this area.

The species composition on Principe consisted mainly of gurnards, the species *Dactylopterus volitans* and Seabreams. No biomass estimate was calculated for *Dactylopterus volitans* but the group had this year the highest catch rate observed trough the time series with 74 kg/h compared with 34 kg/h on average for the previous years. The biomass for seabreams was 350 tonnes this year compared with 1100 tonnes in 2007 and 800 tonnes, 1200 tonnes and 1100 tonnes respectively in 2006, 2005 and 2004. Groupers and snappers had catch rates of 40 tonnes each while Carangids was estimated to have an abundance of 30 tonnes and Cephalopods an abundance of 51 tonnes. Rays had an estimated abundance of 5 tonnes while Barracudas was estimated to 3 tonnes. Other species groups were not abundant on the shelf of Príncipe. The lower than previous abundance in Príncipe is mainly due to the low occurrence of seabreams during this survey and may be a reflection of the prevailing environmental

conditions with strong influence of water masses from Gulf of Guinea with low salinity and high temperature. This may have affected the seabreams and moved them to deeper waters making them inaccessible for trawling.

Dactylopterus volitans was the most abundant species in catches also in São Tomé with catch rates of 126 kg/h (Table 4.2). The most important commercial group in São Tomé were this year snappers (mainly *Lutjanus fulgens*). The biomass of snappers was estimated to 410 tonnes, compared with 160 tonnes in 2007 and 200 tonnes in 2006, In 2005 only one catch of snappers were made but the catch was so big that it was decided to exclude it from the overall biomass calculation because it was not considered representative for the overall abundance. In 2004 150 tonnes of snappers was estimated. The second most important group during the survey this year was the seabreams. 290 tonnes was estimated. However, as in Príncipe this was a decrease from previous years results where the catch rates have been around 450 tonnes. The biomass estimate for grunts was 74 tonnes, an increase from previous years while groupers had an estimate biomass of 44 tonnes. The biomass of carangids, cephalopods, and barracudas were estimated at 91 tonnes, 45 tonnes and 33 tonnes respectively. Other species were of less importance.

The marine fishes of the islands of São Tomé and Príncipe have been little studied over the course of the islands' history dating to the late 1400s, when the islands were first settled by Europeans. During the colonial period, there appeared to have been little interest in the marine resources of the islands, and only a sprinkling of publications, primarily by Balthazar Osorio of the Museu Bocage in Lisbon in the late 1800s, documented the fish fauna. Following independence from Portugal in 1975, the Democratic Republic of São Tomé et Príncipe was formed as one of the smallest and poorest nations in the world. The entire population in 2003 was estimated (by FAO) to be around 160,000, with an economy that relied heavily on agriculture, primarily cacao. An artisanal fishery apparently flourished after independence, as such activities provided an easy means by which a person could gain some income and provide family with an important food source. Such artisanal fisheries currently account for an estimated 60-70% of the protein consumed by the population. Currently, offshore fishery resources of São Tomé and Príncipe are exploited by foreign vessels licensed by the government; these licenses provide important foreign currency needed to purchase imported manufactured products, almost none of which is produced on the islands. (Foreign aid is the most important resource by which the government is able to operate, and the infrastructure maintained and improved.) The lack of adequate monitoring and enforcement capabilities limits the ability of the government to properly regulate the offshore fisheries, and it can be assumed that much unregulated fisheries is surreptitiously conducted.

The country is currently at an inflection point where the potential for greatly increased economic development and consequent disturbances to the marine and terrestrial

environments loom large. Undersea oil resources have been located in territorial waters to the north of Príncipe adjacent to the EEZ of Nigeria. There are talk of building a deepwater port and oil-storage facilities on São Tomé. It can only be hoped that revenues accrued from oil will be used wisely to enhance the economic condition of the country's inhabitants and not destroy the pristine nature of the islands and its waters. It is important to record the country's biodiversity and advertise its uniqueness to the general populous, so as to instill a conscience of ownership and to ensure its proper preservation and use; the exploitable natural resources must also be documented and their condition monitored over time, so as to provide managers and lawmakers with information that will lead to the enactment of sustainable regulations of these resources. A major goal of the R/V *Dr Fridtjof Nansen* surveys in São Tomé and Príncipe has been to provide the faunal-assessment information that is vital to understand, regulate, and protect the marine resources of São Tomé and Príncipe . There is a urgent need to follow up these surveys in the years to come.

Table 3.3 São Tomé and Príncipe, biomass estimates from the swept area trawl survey in 2004, 2005, 2006, 2007 and 2010.

Area	Year	Seabreams	Grunts	Croakers	Groupers	Snappers	Brachy. aur.	Sharks	Rays	Barracudas	Cephalopod	Ariomma	Carangids	Total for the groups
Príncipe	2010	350	0	0	40	40	0	0	5	3	51	0	30	518
	2007	1124	0	0	78	658	0	1366 1)	6	0	39	0	41	1946 1)
	2006	794	0	0	0	4	0	0	16	0	129	2	14	959
	2005	1223	0	0	0	0	0	0	0	0	132	0	23	1378
	2004	1106	0	0	0	0	-	0	0	0	75	0	18	1199
São Tomé	2010	290	74	0	44	408	0	0	1	33	45	0	91	986
	2007	449	21	0	37	159	0	4	5	1	29	0	25	730
	2006	471	5	0	4	202	1	0	8	12	45	0	81	829
	2005	456	42	0	131	4895 1)	76	0	0	0	92	0	13	810 1)
	2004	397	19	0	127	147	-	6	4	0	66	0	21	787

1) Values not included in the total. The biomass is due to one very large catch and is not considered representative for the overall abundance.

4.6 Fishing trials São Tomé

As part of the survey a fishing trial was conducted to determine changes in catch rates and species composition of demersal fish over a 24 h period. Two trawl stations were selected at about 70 m, (station 1) and 60 m bottom depth (station 2) and was trawled repeatedly every 5 h from 18/5 – 19/5. Station 1 was slightly closer to the shelf break, but conditions on the two stations was otherwise similar. The catch was worked up in the same manner as during all the other trawl stations and catch rates were compared from haul to haul. Night-time was defined as from 17:30 until 05:30 in the morning. Figure 4.1 show a screen shot of the ships plotter depicting the two trawl stations that were used during the fishing trial. The bottom was mapped en-route between the two stations and is shown here with colours describing “bottom hardness” Red been the hardest and steepest areas while blue indicate flat and softer surfaces. The bottom substrate on both selected stations was sandy.

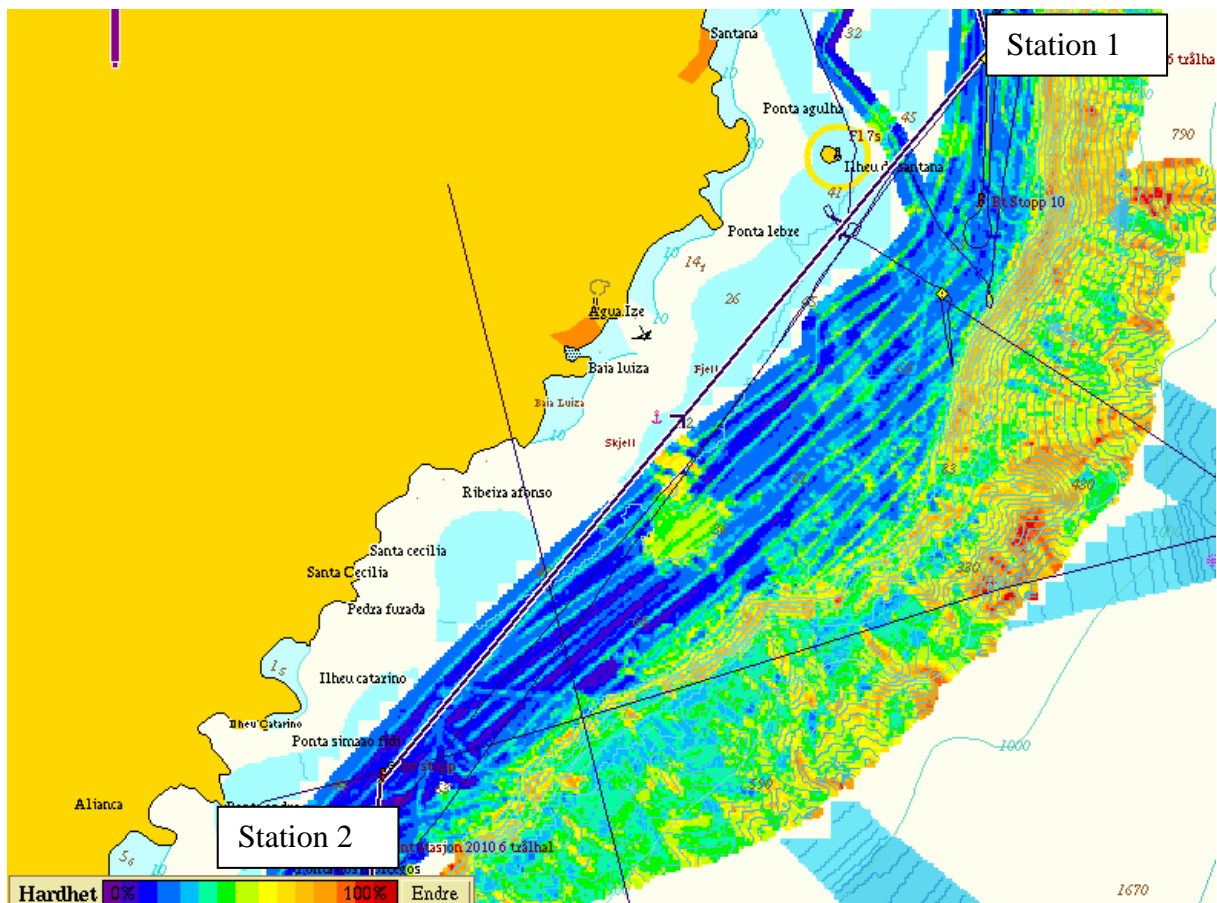
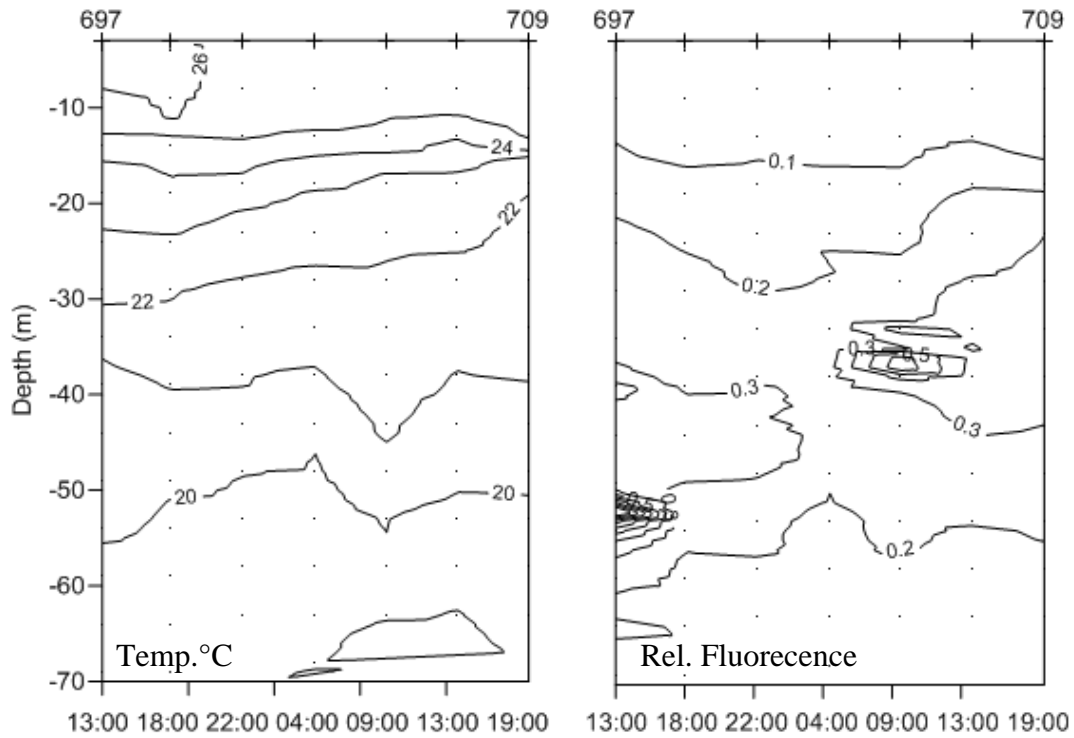


Figure 4.1 A plotter screenshot showing the topography of the shelf and bottom “hardness” the two stations that were trawled repeatedly during the dial experiment. Station 1 at the upper right corner and station two at the lower left.

Temperature recordings by CTD showed that the temperature was relatively stable over the time period but became slightly cooler, especially at station 1. The relative fluorescence showed an concentration of the phytoplankton layer during the night and a slight upward movement (vertical migration), Figure 4.2.

a) Station 1



b) Station 2

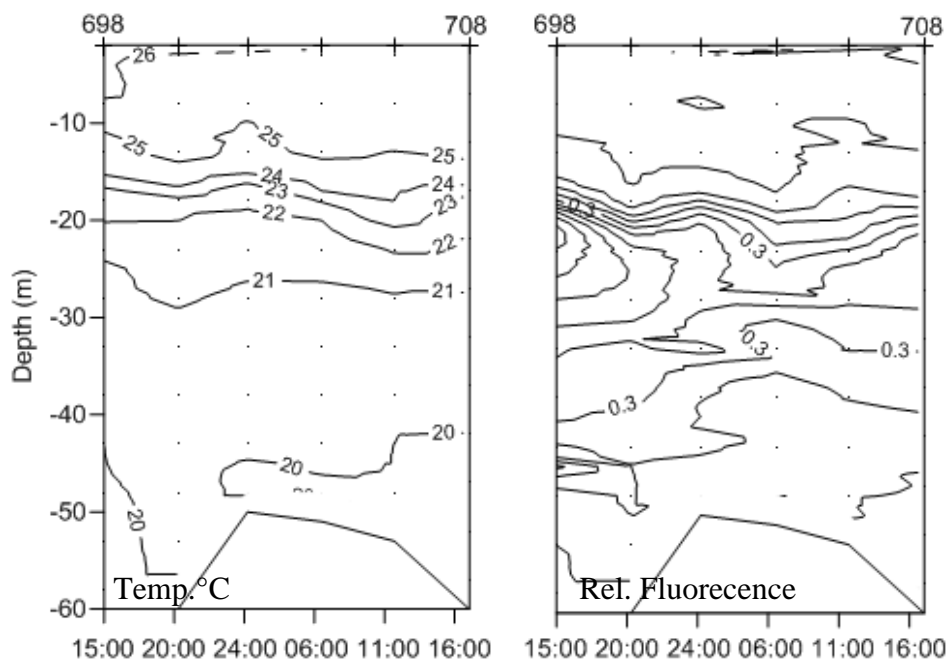


Figure 4.4 Temperature and relative fluorescence profiles from the two diel stations conducted. a) station 1, b) Station 2.

The total biomass in the trawl catches varied between the two experimental stations but did otherwise show similar trends (Figure 4.3). Please note the y-axis log scale. The figure only show selected species and trends may be different than shown here for others. In Station 1 the first catch at midday on the 18th was the best catch. Thereafter the catch declined before increasing again at night, decreasing in the morning before a gradual increase throughout the day. This trend was followed by most species. Looking closely at the catch of Congo dentex, *Dentex congoensis*. One observes a clear diurnal variation in catch rate. The catch of this species mainly consisted of juvenile specimens and it is expected that the increasing catch rate during the night is due to juveniles migrating upwards from deeper waters for feeding. Both the *Dactylopterus volitans*, *Pagelus belottii* and the West African goatfish, *Pseudupeneus prayensis*, show similar migration pattern with decreasing catches at sunset and increasing later in the night before another dip can be observed in the morning. During the day increasing catch rates are experienced. This pattern is probably due to increased feeding migration at dusk and dawn. The fish move up in the water column in search for food and are less accessible for the trawl.

At station two overall catch rates are slightly decreasing throughout the period. A small dip can be seen in catch rates during the middle of the night. Both *Dactylopterus volitans*, and the *Pseudupeneus prayensis* show similar trends as at station 1 while the *Pagelus bellottii* show a less clear trend and a clear decline in catches that may indicate that this species is been moving away from the area probably due to the disturbance by the trawling. *Galeoides decadactylus* show an asynchron catch rate with the other species. Catches are decreasing during the night, increasing in the morning and stay at higher than night level during the rest of the day. Similar the *Pagrus caeruleostictus* showed a declining trend during the night and an increasing trend during the day but with very gradual changes.

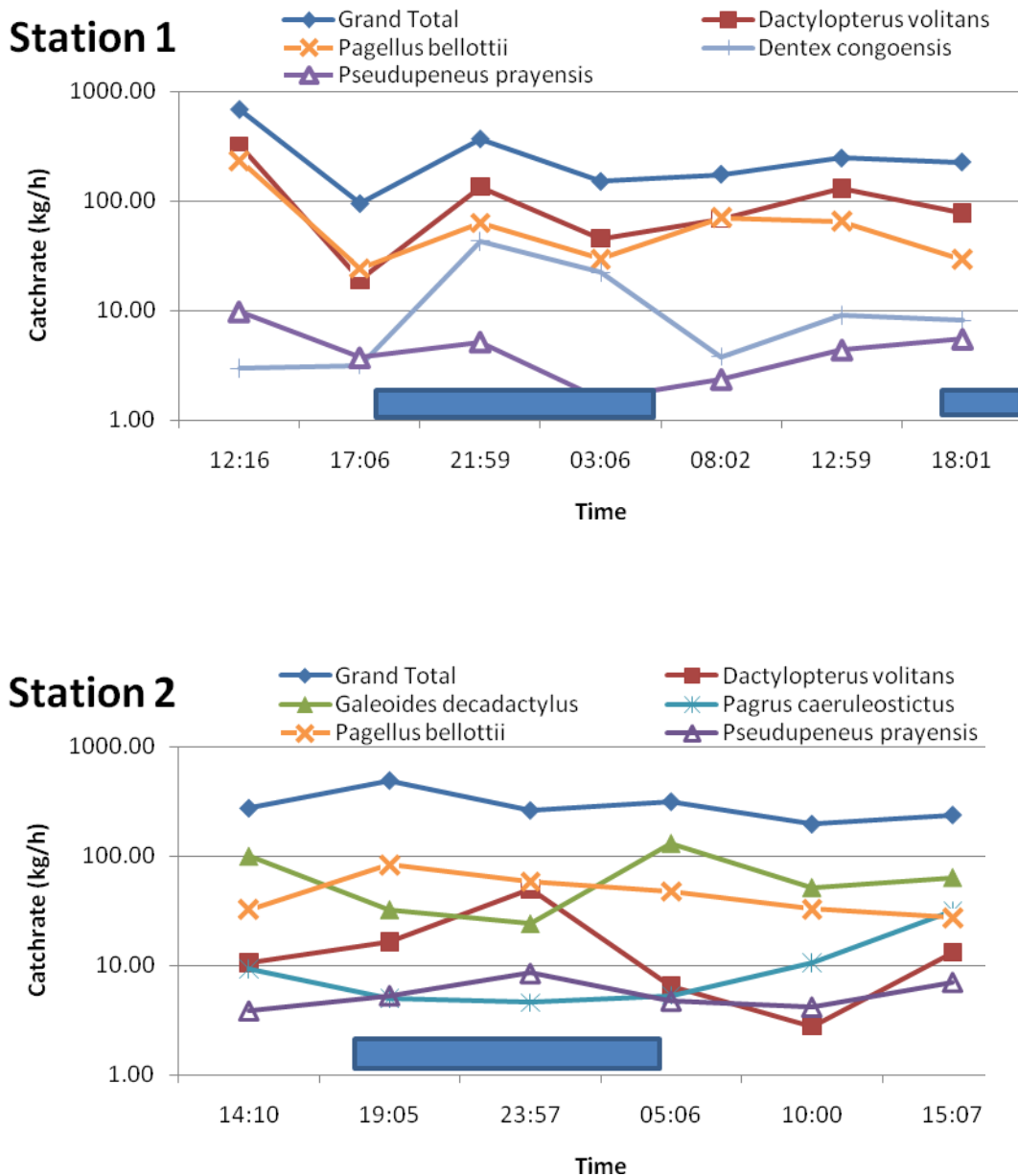


Figure 4.3 Catch experiments showing catch rates in total and for some selected species over the 30 h period.

Figure 4.4 shows the numbers of species and species groups found during the two diurnal stations. It shows a similar trend on both stations with increasing catch rates during the night. About twice the numbers of species were found during the night stations. This is probable species that can be found in deeper depths during day and that migrates up on the shelf during the night to feed. Among these were many smaller species, Myctophides etc.

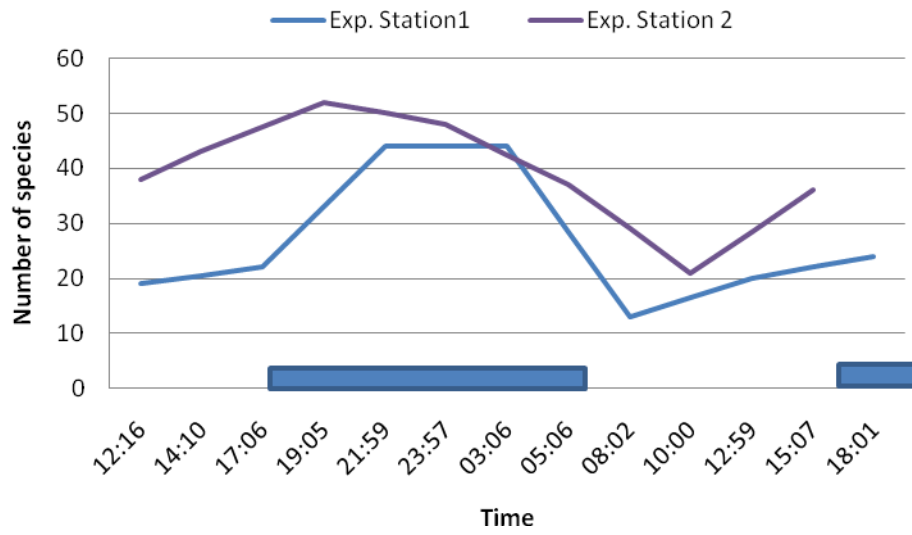


Figure 4.4 Numbers of species and species groups found during the two diurnal stations.

Annex I Records of fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 1
 DATE :11.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°31.57
 start stop duration Lon E 7°28.35
 TIME :09:10:03 09:37:46 27.7 (min) Purpose : 3
 LOG : 9598.96 9600.31 1.4 Region : 3220
 FDEPTH: 58 61 Gear cond.: 0
 BDEPTH: 58 61 Validity : 0
 Towing dir: 0° Wire out : 160 m Speed : 2.9 kn
 Sorted : 19 Total catch: 19.45 Catch/hour: 42.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Sepia officinalis	16.77	24	39.85	4
Pagellus bellottii	8.16	24	19.38	2
Pagrus caeruleostictus	7.36	9	17.48	3
Caranx crysos	5.95	4	14.14	1
Fistularia petimba	3.25	11	7.71	
Rypticus saponaceus	0.26	2	0.62	
Diodon holocanthus	0.17	2	0.41	
Alloteuthis africana	0.11	45	0.26	
Dentex congoensis	0.06	2	0.15	
Total	42.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 2
 DATE :11.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°32.60
 start stop duration Lon E 7°27.62
 TIME :11:04:10 11:30:16 26.1 (min) Purpose : 3
 LOG : 9609.95 9611.23 1.3 Region : 3220
 FDEPTH: 48 57 Gear cond.: 0
 BDEPTH: 48 57 Validity : 0
 Towing dir: 0° Wire out : 135 m Speed : 2.9 kn
 Sorted : 6 Total catch: 5.68 Catch/hour: 13.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagrus caeruleostictus	7.75	16	59.32	5
Lethrinus atlanticus	4.09	11	31.33	6
Decapterus punctatus	0.53	2	4.05	
Aulostomus strigosus	0.32	2	2.46	
Chilomycterus spinosus mauret.	0.23	2	1.76	
Alloteuthis africana	0.14	46	1.06	
Squillidae	0.00	2	0.02	
Total	13.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 3
 DATE :11.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°41.18
 start stop duration Lon E 7°28.74
 TIME :12:52:49 13:23:45 30.9 (min) Purpose : 3
 LOG : 9620.86 9622.42 1.6 Region : 3220
 FDEPTH: 51 48 Gear cond.: 0
 BDEPTH: 51 48 Validity : 0
 Towing dir: 0° Wire out : 155 m Speed : 3.0 kn
 Sorted : 165 Total catch: 164.58 Catch/hour: 319.37

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	271.67	1063	85.07	7
Pagrus caeruleostictus	14.65	23	4.59	8
Acanthostracion guineensis	10.67	82	3.34	
Sepia officinalis	8.25	10	2.58	11
Fistularia petimba	3.16	10	0.39	
Pagellus bellottii	3.14	12	0.98	9
Balistes caprisicus	2.81	6	0.88	
Psettodes belcheri	1.67	4	0.52	10
Caranx crysos	1.40	4	0.44	
Balistes punctatus	0.85	2	0.27	
Seriola carpenteri	0.49	2	0.15	
Decapterus punctatus	0.45	2	0.14	
Chilomycterus spinosus mauret.	0.16	2	0.05	
Total	319.37		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 4
 DATE :11.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°43.00
 start stop duration Lon E 7°26.09
 TIME :15:21:16 15:52:16 31.0 (min) Purpose : 3
 LOG : 9635.42 9637.09 1.7 Region : 3220
 FDEPTH: 26 36 Gear cond.: 0
 BDEPTH: 26 36 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 3.2 kn
 Sorted : 82 Total catch: 323.23 Catch/hour: 625.61

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Acanthostracion guineensis	415.16	3972	66.36	
Dactylopterus volitans	120.77	592	19.31	
Lethrinus atlanticus	18.87	64	3.02	16
Diodon holocanthus	15.48	0	2.48	
Decapterus macarellus	10.84	74	1.73	17
Sepia officinalis	10.35	27	1.66	19
Carangoides bartholomaei	9.87	15	1.58	67
Fistularia tabacaria	7.35	17	1.18	
Balistes caprisicus	5.03	17	0.80	
Pagrus caeruleostictus	2.86	15	0.46	14
Selar crumenophthalmus	2.44	8	0.39	13
Sphyræna sphyraena	1.94	8	0.31	18
Bothus guibei	1.51	10	0.24	
Balistes punctatus	0.95	2	0.15	
Caranx crysos	0.77	6	0.12	15
Stephanolepis hispidus	0.72	4	0.11	
Fistularia petimba	0.56	2	0.09	
Torpedo sp.	0.10	2	0.02	
Total	625.59		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 5
 DATE :11.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°40.74
 start stop duration Lon E 7°20.19
 TIME :17:20:16 17:50:07 29.9 (min) Purpose : 3
 LOG : 9647.13 9648.67 1.6 Region : 3220
 FDEPTH: 40 38 Gear cond.: 0
 BDEPTH: 40 38 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.1 kn
 Sorted : 49 Total catch: 48.66 Catch/hour: 97.81

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Acanthostracion guineensis	60.30	567	61.65	
Pagrus caeruleostictus	11.86	16	12.12	20
Dactylopterus volitans	6.13	26	6.27	25
Fistularia tabacaria	3.82	10	3.90	
Diodon holocanthus	2.95	16	3.02	
Lethrinus atlanticus	2.27	6	2.32	22
Pagellus bellottii	2.23	4	2.28	21
Fistularia petimba	2.21	8	2.26	
Sphyræna sphyraena	2.09	6	2.14	24
Sepia officinalis	1.41	4	1.44	26
Bothus guibei	1.03	4	1.05	
Aluterus heudelotii	0.66	2	0.68	
Pseudupeneus prayensis	0.52	2	0.53	23
Decapterus punctatus	0.32	2	0.33	27
Total	97.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 6
 DATE :12.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°40.71
 start stop duration Lon E 7°17.86
 TIME :07:01:47 07:31:36 29.8 (min) Purpose : 3
 LOG : 9712.34 9713.83 1.5 Region : 3220
 FDEPTH: 63 57 Gear cond.: 0
 BDEPTH: 63 57 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 3.0 kn
 Sorted : 115 Total catch: 114.71 Catch/hour: 230.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	74.47	322	32.26	30
Paranthias furcifer	52.13	368	22.58	29
Lutjanus fulgens	47.40	83	20.53	28
Pagellus bellottii	14.39	68	6.23	32
Pagrus caeruleostictus	13.18	22	5.71	31
Sepia officinalis	6.54	10	2.83	33
Seriola rivoliana	4.03	2	1.74	
Acanthostracion guineensis	3.97	40	1.72	
Trachinus radiatus	3.48	4	1.51	
Scyllarides herklotsii	2.68	2	1.16	35
Rypticus saponaceus	1.61	14	0.70	
Fistularia petimba	0.97	4	0.42	
Torpedo torpedo	0.93	2	0.40	
Lethrinus atlanticus	0.85	2	0.37	
Pseudupeneus prayensis	0.60	4	0.26	34
Aluterus heudelotii	0.60	4	0.26	
URCHINS	0.58	2	0.25	
Torpedo spotted	0.58	2	0.25	
Stephanolepis hispidus	0.56	4	0.24	
Diodon holocanthus	0.54	6	0.24	
Alloteuthis africana	0.34	147	0.15	
Chilomycterus spinosus mauret.	0.20	2	0.09	
Decapterus macarellus	0.14	2	0.06	
CONGRIDAE	0.06	20	0.03	
Anthias anthias	0.04	2	0.02	
Total	230.88		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 7
 DATE :12.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°33.41
 start stop duration Lon E 7°17.64
 TIME :09:11:08 09:41:32 30.4 (min) Purpose : 3
 LOG : 9725.36 9726.86 1.5 Region : 3220
 FDEPTH: 67 65 Gear cond.: 0
 BDEPTH: 67 65 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.0 kn
 Sorted : 54 Total catch: 54.29 Catch/hour: 107.19

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	58.34	399	54.43	36
Dactylopterus volitans	21.03	67	19.62	37
Pagrus caeruleostictus	15.00	14	14.00	38
Lutjanus fulgens	1.88	2	1.75	39
Torpedo torpedo num. spots	1.68	4	1.57	
Fistularia petimba	1.68	6	1.57	
SALPS	1.68	0	1.57	
Alloteuthis africana	1.54	890	1.44	
Bodianus speciosus	1.28	4	1.20	40
Scyllarides herklotsii	0.99	2	0.92	
Zeus capensis	0.79	2	0.74	
Torpedo 5 weak spots	0.49	2	0.46	
Syacium micrurum	0.47	4	0.44	
Dentex congoensis	0.30	18	0.28	41
Fistularia sp., juvenile	0.04	4	0.04	
Total	107.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 8
 DATE :12.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°33.46
 start stop duration Lon E 7°15.00
 TIME :13:21:13 13:51:20 30.1 (min) Purpose : 3
 LOG : 9744.68 9746.17 1.5 Region : 3220
 FDEPTH: 81 80 Gear cond.: 0
 BDEPTH: 81 80 Validity : 0
 Towing dir: 0° Wire out : 240 m Speed : 3.0 kn
 Sorted : 109 Total catch: 108.69 Catch/hour: 216.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	187.25	1518	86.48	42
Dactylopterus volitans	17.13	42	7.91	44
Pagrus caeruleostictus	4.98	4	2.30	43
Alloteuthis africana	2.59	1683	1.20	
Fistularia petimba	1.59	6	0.74	
Dentex congoensis	1.02	22	0.47	46
Syacium micrurum	0.94	6	0.43	
Priacanthus aeneus	0.80	2	0.37	45
Ariomma bondi	0.12	14	0.06	
São Tomé and Príncipe hanolepis hispidus			0.10	2
Lepidotrigla carolae	0.01	2	0.00	
Total	216.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 9
 DATE :12.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°29.73
 start stop duration Lon E 7°11.11
 TIME :15:12:57 15:43:06 30.2 (min) Purpose : 3
 LOG : 9754.83 9756.33 1.5 Region : 3220
 FDEPTH: 85 84 Gear cond.: 0
 BDEPTH: 85 94 Validity : 0
 Towing dir: 0° Wire out : 240 m Speed : 3.0 kn
 Sorted : 21 Total catch: 20.79 Catch/hour: 41.36

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	18.60	74	44.97	47
Dactylopterus volitans	8.85	28	21.40	48
Sphoeroides pachgaster	4.87	6	11.78	
Fistularia petimba	2.84	10	6.88	
Sepia officinalis	1.31	8	3.17	49
Caranx crysos	1.25	2	3.03	
Alloteuthis africana	1.09	302	2.65	
Zeus faber	1.05	6	2.55	
Torpedo torpedo few spots	0.99	2	2.41	
Dentex congoensis	0.32	12	0.77	50
Trachinus armatus	0.16	2	0.38	
CORAL	0.00	2	0.00	
Total	41.36		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 10
 DATE :12.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°26.24
 start stop duration Lon E 7°17.99
 TIME :17:23:40 17:53:20 29.7 (min) Purpose : 3
 LOG : 9768.05 9769.58 1.5 Region : 3220
 FDEPTH: 76 71 Gear cond.: 0
 BDEPTH: 76 71 Validity : 0
 Towing dir: 0° Wire out : 205 m Speed : 3.1 km
 Sorted : 49 Total catch: 49.41 Catch/hour: 99.92

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
SALPS	40.44	0	40.48	
Pagellus bellottii	34.38	233	34.41	51
Dactylopterus volitans	7.08	30	7.08	52
Sepia officinalis	5.62	34	5.63	54
Fistularia petimba	5.06	10	5.06	
Trachinus armatus	1.15	18	1.15	56
Zeus faber	0.91	2	0.91	
Raja miraletus	0.87	4	0.87	
Chelidonichthys lastoviza	0.69	18	0.69	
Dentex congoensis	0.69	24	0.69	55
Uranoscopus pöllii	0.63	4	0.63	
Trachinus radiatus	0.61	2	0.61	
Pseudupeneus prayensis	0.61	6	0.61	53
Decapterus macarellus	0.49	8	0.49	
Trachinocephalus myops	0.30	2	0.30	
Alloteuthis africana	0.20	61	0.20	
Friacanthus arenatus	0.20	2	0.20	
Total	99.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 11
 DATE :12.05.2010 GEAR TYPE: PT NO: 7 POSITION:Lat N 1°28.88
 start stop duration Lon E 7°7.77
 TIME :20:09:30 21:10:46 61.3 (min) Purpose : 1
 LOG : 9786.14 9789.57 3.4 Region : 3220
 FDEPTH: 10 10 Gear cond.: 0
 BDEPTH: 373 466 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.4 km
 Sorted : 2 Total catch: 1.88 Catch/hour: 1.84

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Cubiceps pauciradiatus	1.24	43	67.48	
Hirundichthys affinis	0.16	1	8.50	
Illex coindetii	0.12	3	6.38	
Neolates tripes	0.12	6	6.38	
Todaropsis eblanae	0.11	2	5.84	
MYCTOPHIDAE	0.05	41	2.66	
SYNODONTIDAE	0.02	36	1.06	
Leptocephalus	0.01	5	0.80	
BOTHIDAE, juvenile	0.01	22	0.58	
ISOPODS	0.00	3	0.16	
APOGONIDAE, juvenile	0.00	6	0.16	
Total	1.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 12
 DATE :13.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°37.14
 start stop duration Lon E 7°20.88
 TIME :06:56:54 07:27:24 30.5 (min) Purpose : 3
 LOG : 9830.79 9832.31 1.5 Region : 3220
 FDEPTH: 38 47 Gear cond.: 0
 BDEPTH: 38 47 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.0 km
 Sorted : 186 Total catch: 186.05 Catch/hour: 366.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Drepane africana	210.49	366	57.51	57
Dactylopterus volitans	114.10	479	31.17	58
Albula vulpes	14.56	18	3.98	60
CARANGIDAE	8.85	6	2.42	61
Balistes capricus	6.30	10	1.72	
Acanthostracion guineensis	4.52	22	1.24	
Lutjanus gorensis	2.64	2	0.72	62
Alectis alexandrinus	2.62	2	0.71	59
Carangoides bartholomaei	1.38	2	0.38	
Bothus guibei	0.31	2	0.09	
Pagellus bellottii	0.18	2	0.05	
Pagrus caeruleostictus	0.06	2	0.02	
Total	366.00		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 13
 DATE :13.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°26.31
 start stop duration Lon E 7°26.61
 TIME :13:34:59 14:05:31 30.5 (min) Purpose : 3
 LOG : 9872.32 9873.89 1.6 Region : 3220
 FDEPTH: 84 88 Gear cond.: 0
 BDEPTH: 84 88 Validity : 0
 Towing dir: 0° Wire out : 230 m Speed : 3.1 km
 Sorted : 30 Total catch: 29.65 Catch/hour: 58.26

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	21.02	102	36.09	63
Pagrus caeruleostictus	15.72	14	26.98	64
Dactylopterus volitans	9.04	37	15.51	65
Alloteuthis africana	5.21	1847	8.94	
Fistularia petimba	4.22	12	7.25	
Sepia officinalis	1.96	22	3.37	66
Chilomycterus spinosus mauret.	0.57	2	0.98	
Zeus faber	0.39	4	0.67	
Dentex congoensis	0.08	4	0.13	
Carapus acus	0.04	2	0.07	
Ariomma bondi	0.00	2	0.01	
Sea cucumber (bread like)	0.00	2	0.00	
Total	58.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 14
 DATE :13.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 1°30.32
 start stop duration Lon E 7°18.69
 TIME :15:26:09 15:56:51 30.7 (min) Purpose : 3
 LOG : 9883.13 9884.49 1.4 Region : 3220
 FDEPTH: 63 65 Gear cond.: 0
 BDEPTH: 63 65 Validity : 0
 Towing dir: 0° Wire out : 165 m Speed : 2.7 km
 Sorted : 170 Total catch: 169.79 Catch/hour: 331.84

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	310.75	1661	93.65	68
Pagellus bellottii	7.82	35	2.36	69
Pagrus caeruleostictus	5.08	20	1.53	70
Sepia officinalis	1.47	12	0.44	71
Sea cucumber	1.43	2	0.43	
Alloteuthis africana	1.37	328	0.41	
Acanthostracion guineensis	1.37	4	0.41	
Fistularia petimba	0.90	2	0.27	
Torpedo torpedo	0.88	2	0.27	
Chilomycterus spinosus mauret.	0.51	2	0.15	
Dentex congoensis	0.23	8	0.07	72
CARAPIDAE	0.04	2	0.01	
Total	331.84		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 15
 DATE :13.05.2010 GEAR TYPE: PT NO: 5 POSITION:Lat N 1°17.00
 start stop duration Lon E 7°13.66
 TIME :18:48:47 19:36:59 48.2 (min) Purpose : 1
 LOG : 9898.60 9901.36 2.8 Region : 3220
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 671 1087 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 3.4 km
 Sorted : 29 Total catch: 29.12 Catch/hour: 36.26

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Ommastrephes bartramii	21.79	189	60.10	73
MYCTOPHIDAE sp. small/mix	4.71	5883	12.98	
SALPS	4.02	0	11.09	
MYCTOPHIDAE sp. silver	1.72	515	4.74	
MYCTOPHIDAE sp. large	1.69	463	4.67	
Cubiceps pauciradiatus	1.12	40	3.09	
Neolates tripes	0.93	45	2.58	
Cypselurus cyanopterus	0.27	1	0.76	
Total	36.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 16
 DATE :14.05.2010 GEAR TYPE: PT NO: 5 POSITION:Lat N 0°18.07
 start stop duration Lon E 6°27.85
 TIME :18:53:30 19:37:13 43.7 (min) Purpose : 1
 LOG : 19.48 22.23 2.8 Region : 3210
 FDEPTH: 0 0 Gear cond.: 8
 BDEPTH: 598 579 Validity : 4
 Towing dir: 0° Wire out : 120 m Speed : 3.8 km
 Sorted : 1 Total catch: 1.38 Catch/hour: 1.89

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Ommastrephes bartramii	1.59	21	84.06	74
Sardinella maderensis	0.23	43	12.32	75
Euthynnus alletteratus, juvenile	0.03	1	1.45	
MYCTOPHIDAE	0.03	27	1.45	
Mullidae juvenile	0.01	1	0.72	
Total	1.89		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 17
 DATE :15.05.2010 GEAR TYPE: PT NO: 4 POSITION:Lat N 0°7.12
 start stop duration Lon E 6°25.07
 TIME :00:50:37 01:20:40 30.1 (min) Purpose : 1
 LOG : 33.15 34.62 1.5 Region : 3210
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 1256 1081 Validity : 0
 Towing dir: 0° Wire out : 140 m Speed : 2.9 km
 Sorted : 9 Total catch: 9.49 Catch/hour: 18.94

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
DASYATIIDAE	13.18	2	69.58	
MYCTOPHIDAE sp. small/mix	2.76	2755	14.55	
MYCTOPHIDAE sp. large	0.90	84	4.74	
Nesiarichthys nasutus	0.70	20	3.69	
NOTACANTHIDAE	0.44	148	2.32	
Small squids	0.40	0	2.11	
Leptocephalus	0.22	16	1.16	
Cubiceps pauciradiatus	0.15	6	0.79	
Cryptoparas couesii	0.04	2	0.21	
Eumecichthys fiski	0.03	2	0.15	
Euphausiacea	0.02	50	0.13	
Taractichthys cf steindacneri, juvenile	0.02	8	0.11	
Howella sp.	0.02	22	0.11	
Cubiceps sp.	0.01	2	0.07	
Maurollichs muelleri	0.01	16	0.07	
Promethichthys prometheus	0.01	2	0.06	
MYCTOPHIDAE sp. slender	0.01	4	0.05	
PARALEPIDIDAE	0.01	2	0.05	
Nemichthys curvirostris	0.00	2	0.01	
BALISTIDAE, juvenile	0.00	10	0.01	
Neolates tripes	0.00	2	0.01	
Phyllosome	0.00	2	0.01	
BOTHIDAE, juvenile	0.00	8	0.01	
Diplophos sp.	0.00	0	0.00	
ASTRONESTHIDAE	0.00	2	0.00	
MALACOSTEIDAE	0.00	4	0.00	
MALACOSTEIDAE	0.00	2	0.00	0
Total	18.94		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 18
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°8.49
 start stop duration Lon E 6°28.06
 TIME :06:45:26 07:06:13 20.8 (min) Purpose : 3
 LOG : 52.51 53.57 1.1 Region : 3210
 FDEPTH: 71 75 Gear cond.: 0
 BDEPTH: 71 75 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 3.1 kn
 Sorted : 67 Total catch: 67.14 Catch/hour: 193.95

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	108.33	760	55.85	76
Priacanthus arenatus	19.04	66	9.82	91
Lutjanus fulgens	14.47	38	7.46	79
Pseudupeneus prayensis	11.01	95	5.67	82
Dentex canariensis	7.28	3	3.75	83
Fistularia petimba	7.08	17	3.65	
Paranthias furcifer	7.08	38	3.65	77
Pagrus caeruleostictus	6.18	9	3.19	80
Dactylopterus volitans	5.06	23	2.61	78
Zeus faber	2.05	3	1.06	
Seriola carpenteri	1.73	9	0.89	
Chaetodon marcellae	1.47	3	0.76	
Selar crumenophthalmus	0.90	3	0.46	
Diodon holocanthus	0.64	3	0.33	
Anthias anthias	0.58	6	0.30	
Allotautis africana	0.52	107	0.27	
Sepia officinalis	0.26	6	0.13	
Dentex congoensis	0.26	12	0.13	
Apogon sp.	0.03	3	0.01	
Total	193.95		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 19
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°5.60
 start stop duration Lon E 6°29.79
 TIME :08:49:42 09:08:15 18.6 (min) Purpose : 3
 LOG : 63.56 64.46 0.9 Region : 3210
 FDEPTH: 42 47 Gear cond.: 0
 BDEPTH: 42 47 Validity : 0
 Towing dir: 0° Wire out : 120 m Speed : 2.9 kn
 Sorted : 77 Total catch: 77.32 Catch/hour: 250.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	161.73	1271	64.66	84
Pagellus bellottii	37.36	220	14.94	85
Balistes capricus	13.84	23	5.54	
Lethrinus atlanticus	11.81	23	4.72	87
Pagrus caeruleostictus	11.32	58	4.53	86
Allotautis africana	3.65	1514	1.46	
Pseudupeneus prayensis	2.78	23	1.11	88
Balistes punctatus	1.84	3	0.74	
Octopus vulgaris	1.46	3	0.58	
Sepia officinalis	1.39	6	0.56	89
Seriola carpenteri	1.36	6	0.54	
Chelidonichthys gabonensis	0.61	3	0.25	
Fistularia petimba	0.58	3	0.23	
Starfish	0.23	3	0.09	
Syacium micrurum	0.06	3	0.03	
Grammolites gruvelli	0.03	3	0.01	
Decapterus punctatus	0.03	3	0.01	
Brachydeuterus auritus	0.01	3	0.00	
Total	250.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 20
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°1.14
 start stop duration Lon E 6°29.64
 TIME :11:44:35 12:15:25 30.8 (min) Purpose : 3
 LOG : 74.90 76.44 1.5 Region : 3210
 FDEPTH: 82 56 Gear cond.: 0
 BDEPTH: 82 56 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.0 kn
 Sorted : 203 Total catch: 203.21 Catch/hour: 395.35

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	182.88	1654	46.26	161
Decapterus macarellus	114.79	611	29.03	164
Pagellus bellottii	46.69	276	11.81	162
Sepia officinalis	17.32	66	4.38	163
Priacanthus arenatus	13.62	62	3.44	165
Chilomycterus spinosus mauret.	4.81	37	1.22	
Pseudupeneus prayensis	3.04	16	0.77	166
Syacium micrurum	3.02	21	0.76	
Epinephelus aeneus	2.33	2	0.59	168
Zeus faber	1.85	2	0.47	
Aluterus heudelotii	1.54	6	0.39	
Acanthostracion guineensis	1.17	4	0.30	
Octopus vulgaris	0.84	2	0.21	
Selar crumenophthalmus	0.51	2	0.13	
Seriola carpenteri	0.41	2	0.10	
Chelidonichthys gabonensis	0.31	2	0.08	
Arnoglossus imperialis	0.14	16	0.03	
Dentex congoensis	0.10	10	0.02	167
Citharus linguatula	0.02	2	0.00	
Total	395.35		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 21
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°0.30
 start stop duration Lon E 6°30.36
 TIME :13:53:16 14:24:51 31.6 (min) Purpose : 3
 LOG : 85.52 87.30 1.8 Region : 3210
 FDEPTH: 25 25 Gear cond.: 0
 BDEPTH: 25 25 Validity : 0
 Towing dir: 0° Wire out : 130 m Speed : 3.4 kn
 Sorted : 301 Total catch: 301.11 Catch/hour: 571.90

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	254.51	2376	44.50	92
Chelonia mydas	132.95	4	23.25	
Sphyræna sphyraena	56.98	277	9.96	93
Lagocephalus lagocephalus DEAD	41.79	84	7.33	
Acanthostracion guineensis	18.23	146	3.19	
Decapterus punctatus	13.96	146	2.44	97
Lethrinus atlanticus	8.36	25	1.46	95
Balistes punctatus	7.79	32	1.36	
Decapterus macarellus	7.31	40	1.28	96
Sepia officinalis	6.46	21	1.13	98
Bothus guibe	6.17	30	1.08	
Pagellus bellottii	5.89	32	1.03	94
Diodon holocanthus	2.01	8	0.35	
Aluterus heudelotii	1.92	6	0.34	
Chilomycterus spinosus mauret.	1.86	17	0.33	
Fistularia tabacaria	1.23	4	0.22	
Stephanolepis hispidus	0.83	8	0.16	
Pseudupeneus prayensis	0.76	6	0.13	99
Caranx crysos	0.66	2	0.12	
Scorpaena notata	0.65	4	0.11	
Pagrus caeruleostictus	0.40	6	0.07	100
Xyrichtys novacula	0.23	2	0.04	
Exodromidia sp.	0.23	6	0.04	
Aulostomus strigosus	0.21	2	0.04	
Sphoeroides marmoratus	0.19	4	0.03	
Torpedo torpedo	0.19	2	0.03	
Bothus podas africanus	0.06	2	0.01	
Serranus sp. Heemstra	0.01	2	0.00	
Total	571.90		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 22
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°2.66
 start stop duration Lon E 6°34.96
 TIME :16:22:53 16:49:39 26.8 (min) Purpose : 3
 LOG : 101.10 102.50 1.4 Region : 3210
 FDEPTH: 62 75 Gear cond.: 0
 BDEPTH: 62 75 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 3.1 kn
 Sorted : 52 Total catch: 51.52 Catch/hour: 115.52

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagellus bellottii	35.41	262	30.66	102
Galeoides decadactylus	33.05	90	28.62	101
Fistularia petimba	11.77	40	10.19	
Pagrus caeruleostictus	5.16	20	4.46	107
Sphyræna sphyraena	4.59	9	3.98	108
Scorpaena stephanica	3.36	4	2.91	
Dentex congoensis	3.25	121	2.81	106
Decapterus macarellus	2.47	25	2.13	
Pomadasy incisus	2.24	16	1.94	104
Psettodes belcheri	1.99	2	1.73	
Dactylopterus volitans	1.61	16	1.40	
Pseudupeneus prayensis	1.57	13	1.36	103
Decapterus punctatus	1.39	108	1.20	105
Sphyræna guachancho	1.37	2	1.18	
Sepia officinalis	1.26	2	1.09	
Syacium micrurum	1.03	13	0.89	
Priacanthus arenatus	1.01	4	0.87	
Lagocephalus laevigatus	0.99	2	0.85	
Selene dorsalis	0.69	2	0.60	
Citharus linguatula	0.52	9	0.45	
Chilomycterus spinosus mauret.	0.29	2	0.25	
Brotula barbata	0.20	2	0.17	
Grammolites gruvelli	0.13	2	0.12	
Gobiidae	0.11	27	0.10	
Brachydeuterus auritus	0.02	13	0.02	
Saurida brasiliensis	0.02	9	0.02	
Total	115.52		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 23
 DATE :15.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°4.35
 start stop duration Lon E 6°38.77
 TIME :18:01:32 18:23:34 22.0 (min) Purpose : 2
 LOG : 109.90 111.05 1.2 Region : 3210
 FDEPTH: 56 60 Gear cond.: 0
 BDEPTH: 56 60 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.1 kn
 Sorted : 112 Total catch: 111.97 Catch/hour: 304.82

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pagrus caeruleostictus	91.20	112	29.92	110
Galeoides decadactylus	89.89	192	19.65	109
Dactylopterus volitans	32.67	155	10.72	111
Priacanthus arenatus	24.50	106	8.04	112
Pagellus bellottii	22.73	370	7.46	114
Lutjanus fulgens	15.65	46	5.14	113
Albula vulpes	15.52	22	5.09	115
Pomadasy incisus	11.30	93	3.71	117
Pomadasy rogeri	9.39	11	3.08	116
Syacium micrurum	5.44	147	1.79	
Sepia officinalis	4.33	11	1.42	121
Echelus myrus	3.27	3	1.07	
Pseudupeneus prayensis	2.89	60	0.95	118
Fistularia petimba	1.63	5	0.54	
Balistes capricus	1.55	3	0.51	
Epinephelus goreensis	0.84	8	0.28	119
Decapterus punctatus	0.65	38	0.21	120
Rypticus saponaceus	0.49	3	0.16	
Torpedo torpedo	0.25	3	0.08	
Calappa rubroguttata	0.19	3	0.06	
Chilomycterus spinosus mauret.	0.16	3	0.05	
Peneus notialis	0.16	5	0.05	
Saurida brasiliensis	0.08	33	0.03	
Brachydeuterus auritus	0.03	8	0.01	
Total	304.82		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 24
 DATE :15.05.2010 GEAR TYPE: FT NO: 4 POSITION:Lat S 0°1.50
 start stop duration Lon E 6°34.15
 TIME :19:56:36 20:47:23 50.8 (min) Purpose : 1
 LOG : 118.38 121.24 2.9 Region : 3210
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 812 1071 Validity : 0
 Towing dir: 0° Wire out : 70 m Speed : 3.4 kn
 Sorted : 15 Total catch: 15.20 Catch/hour: 17.96

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
SALPS	7.92	0	44.08	
Selar crumenophthalmus	4.41	17	24.54	122
Myctophidae sp. small/mix	2.40	0	13.36	
Myctophidae sp. large	0.93	299	5.20	
Albula vulpes	0.70	1	3.88	
Neolates tripes	0.56	25	3.09	
Priacanthus arenatus	0.32	2	1.78	
CRANCHIIDAE	0.20	7	1.12	
Synagrops sp.	0.17	7	0.92	
Ommastrephes bartramii	0.17	2	0.92	
Syacium micrurum	0.07	2	0.39	
NOTACANTHIDAE	0.07	11	0.39	
Acistroteuthis-like no hooks	0.05	5	0.26	
Cranchia sp.	0.01	1	0.07	
Total	17.96		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 25
 DATE :16.05.2010 GEAR TYPE: FT NO: 24 POSITION:Lat N 0°4.54
 start stop duration Lon E 6°39.19
 TIME :12:53:43 13:23:52 30.1 (min) Purpose : 3
 LOG : 180.39 181.93 1.6 Region : 3210
 FDEPTH: 62 60 Gear cond.: 0
 BDEPTH: 62 60 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 3.1 kn
 Sorted : 217 Total catch: 216.92 Catch/hour: 431.82

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Pomadasy inciscus	139.35	1445	32.27	123
Dactylopterus volitans	59.72	332	13.83	125
Pagellus bellottii	44.79	297	10.37	127
Epinephelus aeneus	37.62	8	8.71	131
Lutjanus fulgens	35.24	66	8.16	124
Dentex canariensis	27.47	28	6.36	129
Pagrus caeruleostictus	19.91	113	4.61	128
Pseudupeneus prayensis	14.53	213	3.37	126
Sepia officinalis	9.56	16	2.21	132
Fistularia petimba	9.56	30	2.21	
Galeoides decadactylus	4.08	8	0.95	130
Dentex congoensis	3.92	189	0.91	133
Syacium micrurum	3.46	46	0.80	
Pagrus africanus	3.42	2	0.79	136
Psettodes belcheri	3.40	4	0.79	134
Octopus vulgaris	3.34	6	0.77	
Selene dorsalis	3.32	16	0.77	135
Aluterus heudelotii	1.81	4	0.42	
Citharus linguatula	1.77	54	0.41	
Caranx crysos	1.55	2	0.36	
Balistes capricus	1.07	2	0.25	
Rypticus saponaceus	1.06	6	0.24	
Chilomycterus spinosus mauret.	0.52	4	0.12	
Grammolites gruvelli	0.46	8	0.11	
Antennarius cf pardalis	0.34	2	0.08	
Sardinella aurita	0.24	2	0.06	
Penaeus notialis	0.15	6	0.03	
Brachydeuterus auritus	0.14	20	0.03	
GOBIIDAE	0.01	2	0.00	
Total	431.82		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 26
 DATE :16.05.2010 GEAR TYPE: FT NO: 24 POSITION:Lat N 0°8.46
 start stop duration Lon E 6°41.42
 TIME :15:15:48 15:36:01 20.2 (min) Purpose : 3
 LOG : 194.27 195.29 1.0 Region : 3210
 FDEPTH: 54 61 Gear cond.: 0
 BDEPTH: 54 61 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 3.0 kn
 Sorted : 440 Total catch: 439.72 Catch/hour: 1304.81

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Lutjanus fulgens	694.36	1688	53.22	138
Galeoides decadactylus	163.20	439	12.51	142
Acanthurus monroviae	124.63	151	9.55	144
Dactylopterus volitans	74.18	371	5.69	141
Dentex canariensis	42.14	30	3.23	146
Paranthias furcifer	39.17	154	3.00	143
Apsilus fuscus	39.17	62	3.00	140
Pagellus bellottii	31.01	139	2.38	147
Sepia officinalis	18.40	45	1.41	152
Pagrus caeruleostictus	13.35	45	1.02	145
Carangoides bartholomaei	12.61	6	0.97	148
Lutjanus goreensis	7.86	3	0.60	139
Syacium micrurum	6.85	74	0.53	
Pseudupeneus prayensis	5.93	68	0.45	149
Fistularia petimba	5.79	18	0.44	
Psettodes belcheri	4.48	9	0.34	150
Selene dorsalis	3.68	15	0.28	151
Seriola carpenteri	3.29	3	0.25	
Pomadasy rogeri	3.23	3	0.25	
Lethrinus atlanticus	2.49	3	0.19	
Sphyraena sphyraena	2.14	6	0.16	
Torpedo torpedo	2.14	9	0.16	
Citharus linguatula	1.69	47	0.13	
Chilomycterus spinosus mauret.	1.28	6	0.10	
Chaetodon hoefleri	0.74	6	0.06	
Calappa rubroguttata	0.33	3	0.03	
Microchirus frechkopi	0.14	3	0.01	
Canthigaster rostrata	0.10	3	0.01	
Muraena melanotis	0.09	3	0.01	
Serranus accraensis	0.09	3	0.01	
Cronius ruber	0.06	3	0.00	
Dentex congoensis	0.06	9	0.00	
'Mole crab'	0.03	3	0.00	
Grammolites gruvelli	0.03	3	0.00	
Saurida brasiliensis	0.01	3	0.00	
Hermitis, mixed	0.01	3	0.00	
Total	1304.78		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 27
 DATE :16.05.2010 GEAR TYPE: FT NO: 24 POSITION:Lat N 0°15.53
 start stop duration Lon E 6°47.09
 TIME :17:28:21 17:59:01 30.7 (min) Purpose : 3
 LOG : 208.77 210.24 1.5 Region : 3210
 FDEPTH: 64 70 Gear cond.: 0
 BDEPTH: 64 70 Validity : 0
 Towing dir: 0° Wire out : 165 m Speed : 2.9 kn
 Sorted : 221 Total catch: 220.79 Catch/hour: 431.92

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	264.10	2031	61.15	153
Pagellus bellottii	111.51	730	25.82	154
Sepia officinalis	21.52	74	4.98	158
Fistularia petimba	9.98	33	2.31	
Pseudupeneus prayensis	5.28	67	1.22	156
Decapterus punctatus	4.79	200	1.11	160
Sphyraena sphyraena	4.11	12	0.95	157
Dentex congoensis	3.25	192	0.75	159
Syacium micrurum	2.64	18	0.61	
Apsilus fuscus	1.17	2	0.27	
Pomadasy inciscus	1.04	6	0.24	
Chilomycterus spinosus mauret.	0.82	6	0.19	
Trachinus radiatus	0.51	2	0.12	
Ariosoma sp.	0.35	4	0.08	
Uranoscopus polli	0.29	2	0.07	
Calappa rubroguttata	0.22	2	0.05	
Sardinella aurita	0.16	4	0.04	
Trachinus armatus	0.12	2	0.03	
Arnoglossus imperialis	0.04	6	0.01	
Maja sp.	0.02	2	0.00	
Lepidotrigla carolae	0.01	2	0.00	
Total	431.92		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 28
 DATE :17.05.2010 GEAR TYPE: FT NO: 4 POSITION:Lat N 0°5.05
 start stop duration Lon E 6°40.73
 TIME :05:13:20 06:00:15 46.9 (min) Purpose : 1
 LOG : 257.26 259.76 2.5 Region : 3210
 FDEPTH: 0 0 Gear cond.: 0
 BDEPTH: 287 369 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 3.2 kn
 Sorted : 2 Total catch: 1.59 Catch/hour: 2.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Lagocephalus lagocephalus DEAD	1.99	5	98.30	
Fistularia sp., juvenile	0.01	5	0.63	
Apsilus fuscus, juvenile	0.01	4	0.38	
Selene dorsalis, juvenile	0.01	15	0.25	
Alloteuthis africana	0.00	1	0.19	
Tetradontidae - juvenile	0.00	1	0.13	
Abraliopsis sp.	0.00	1	0.06	
Acanthurus monroviae, juvenile	0.00	1	0.06	
Total	2.03		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 29
 DATE :18.05.2010 GEAR TYPE: FT NO: 24 POSITION:Lat N 0°15.52
 start stop duration Lon E 6°47.10
 TIME :12:16:42 12:47:03 30.4 (min) Purpose : 2
 LOG : 299.08 300.54 1.5 Region : 3210
 FDEPTH: 63 69 Gear cond.: 0
 BDEPTH: 63 69 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 2.9 kn
 Sorted : 343 Total catch: 343.47 Catch/hour: 678.79

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	318.18	2217	46.87	169
Pagellus bellottii	233.20	947	34.36	170
Fistularia petimba	55.34	221	8.15	
Sepia officinalis	21.15	59	3.12	174
Pagrus caeruleostictus	14.62	10	2.15	171
Pseudupeneus prayensis	9.70	119	1.43	177
Lutjanus fulgens	6.32	10	0.93	173
Dentex canariensis	4.64	4	0.68	172
Dentex congoensis	2.96	198	0.44	175
Epinephelus aeneus	2.00	2	0.29	176
Alloteuthis africana	1.98	1132	0.29	
Syacium micrurum	1.82	8	0.27	
Octopus vulgaris	1.78	2	0.26	
Chilomycterus spinosus mauret.	1.56	10	0.23	
Apsilus fuscus	1.19	2	0.17	
Seriola carpenteri	0.95	4	0.14	
Selar crumenophthalmus	0.71	2	0.10	
Aluterus heudelotii	0.57	2	0.08	
Decapterus punctatus	0.12	2	0.02	
Total	678.79		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 30
 DATE :18.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°8.74
 start stop duration Lon E 6°41.65
 TIME :14:10:06 14:40:22 30.3 (min) Purpose : 2
 LOG : 309.37 310.97 1.6 Region : 3210
 FDEPTH: 57 65 Gear cond.: 0
 BDEPTH: 57 65 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 3.2 kn
 Sorted : 138 Total catch: 138.46 Catch/hour: 274.54

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Galeoides decadactylus	99.14 276	36.11	178
Pagellus bellottii	32.32 133	11.77	181
Drepane africana	29.54 58	10.76	182
Pomadasy rogeri	18.64 20	6.79	184
Brotula barbata	15.66 36	5.71	185
Pomadasy incisivus	12.10 93	4.41	179
Dactylopterus volitans	10.51 59	3.83	183
Pagrus caeruleostictus	9.22 87	3.36	180
Sepia officinalis	7.53 12	2.74	186
Syacium micrurum	6.36 83	2.32	
Citharus linguatula	4.22 198	1.54	
Psettodes belcheri	4.14 8	1.51	189
Aluterus monoceros	3.91 2	1.42	
Pseudupeneus prayensis	3.85 54	1.40	188
Selene dorsalis	2.88 14	1.05	190
Epinephelus aeneus	2.16 2	0.79	187
Chelidonichthys gabonensis	1.55 6	0.56	
Lutjanus fulgens	1.49 2	0.54	
Octopus vulgaris	1.13 2	0.41	
Aluterus heudelotii	1.03 2	0.38	
Pseudolithus senegalensis	1.03 2	0.38	
Lagocephalus lagocephalus DEAD	0.99 2	0.36	
Calappa peliis	0.87 12	0.32	
Sardinella maderensis	0.81 4	0.30	
Brachydeuterus auritus	0.67 220	0.25	
Lesueurigobius sp.	0.54 135	0.20	
Grammolites gruvelli	0.44 10	0.16	
Dentex congoensis	0.28 22	0.10	
CONGRIDAE	0.26 6	0.09	
Chilomycterus spinosus mauret.	0.24 2	0.09	
Microchirus frechkopi	0.20 6	0.07	
Thorogobius sp.	0.20 48	0.07	
Brachydeuterus auritus	0.18 40	0.07	0
ARCIDAE	0.14 4	0.05	
G A S T R O P O D S	0.08 2	0.03	
Saurida brasiliensis	0.04 18	0.01	
Arnoglossus imperialis	0.04 8	0.01	
MACTRIDAE	0.04 2	0.01	
Scorpaena laevis	0.04 2	0.01	
Priacanthus sp.	0.02 2	0.01	
Cepola sp.	0.02 2	0.01	
'Mole crab'	0.02 6	0.01	
Serranus sp. Heemstra	0.02 2	0.01	
Total	274.54	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 32
 DATE :18.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°9.77
 start stop duration Lon E 6°42.49
 TIME :19:05:35 19:33:49 28.2 (min) Purpose : 2
 LOG : 331.06 332.61 1.6 Region : 3210
 FDEPTH: 65 55 Gear cond.: 0
 BDEPTH: 65 55 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 3.3 kn
 Sorted : 232 Total catch: 232.07 Catch/hour: 493.08

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Physiculus cf huloti	254.96 2	51.71	
Pagellus bellottii	82.86 489	16.80	199
Galeoides decadactylus	32.29 83	6.55	201
Promethichthys prometheus	21.03 501	4.27	
Dactylopterus volitans	16.36 72	3.32	200
Syacium micrurum	10.22 166	2.07	
Boops boops	8.50 261	1.72	
Pomadasy rogeri	5.97 6	1.21	205
MCTOPHIDAE	5.82 903	1.18	
Pomadasy incisivus	5.72 40	1.16	207
Pseudupeneus prayensis	5.31 106	1.08	204
Pagrus caeruleostictus	4.97 70	1.01	202
Sepia officinalis	4.89 38	0.99	209
Fistularia petimba	4.57 11	0.93	
Pseudolithus senegalensis	3.72 4	0.75	206
Lesueurigobius sp.	3.61 1132	0.73	
Dentex congoensis	3.34 370	0.68	203
Citharus linguatula	2.66 125	0.54	
Chilomycterus spinosus mauret.	2.32 11	0.47	
Psettodes belcheri	2.19 11	0.44	208
CONGRIDAE	1.70 57	0.34	
Octopus vulgaris	1.49 4	0.30	
Torpedo 5 very weak spots	0.93 2	0.19	
Priacanthus arenatus	0.87 8	0.18	
Aluterus heudelotii	0.76 2	0.16	
Chilomycterus spinosus mauret.	0.70 4	0.14	0
Sardinella maderensis	0.55 6	0.11	
Seriola carpenteri	0.53 2	0.11	
NETRASPOMATIDAE	0.53 30	0.11	
Calappa peliis	0.45 11	0.09	
Grammolites gruvelli	0.42 11	0.09	
Penaeus notialis	0.36 8	0.07	
Decapterus punctatus	0.34 11	0.07	
Antennarius sp.	0.32 2	0.06	
Lutjanus fulgens	0.30 2	0.06	
Cubiiceps sp.	0.30 32	0.05	
Apogon sp.	0.28 45	0.06	
Arnoglossus imperialis	0.25 62	0.05	
Solenocera africana	0.19 79	0.04	
MURICIDAE	0.15 6	0.03	
ARCIDAE	0.06 4	0.01	
Todaropsis eblanae	0.04 2	0.01	
'Calappa baby'	0.04 6	0.01	0
Starfish	0.04 2	0.01	
Saurida brasiliensis	0.04 11	0.01	
Exodromidia sp.	0.02 2	0.00	0
SQUILLIDAE	0.02 2	0.00	
Physiculus cf huloti	0.02 4	0.00	0
Cepola sp.	0.02 13	0.00	
Serranus sp. Heemstra	0.02 2	0.00	
Tetradonthidae - juvenile, juvenile	0.01 2	0.00	
Apsilus fuscus, juvenile	0.00 2	0.00	
Total	493.08	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 31
 DATE :18.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.48
 start stop duration Lon E 6°47.10
 TIME :17:06:42 17:36:35 29.9 (min) Purpose : 2
 LOG : 322.27 323.65 1.4 Region : 3210
 FDEPTH: 64 71 Gear cond.: 0
 BDEPTH: 64 71 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 2.8 kn
 Sorted : 47 Total catch: 46.91 Catch/hour: 94.17

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Pagellus bellottii	24.09 141	25.58	191
Dactylopterus volitans	19.27 134	20.46	192
Fistularia petimba	13.35 38	14.18	
Sepia officinalis	6.16 18	6.54	198
Pomadasy incisivus	5.72 38	6.08	194
Pseudupeneus prayensis	3.71 42	3.94	193
Drepane africana	3.61 6	3.84	
Dentex congoensis	3.17 181	3.37	195
Octopus vulgaris	3.11 4	3.30	
Selar crumenophthalmus	2.75 8	2.92	
Galeoides decadactylus	2.71 8	2.88	196
Syacium micrurum	1.65 8	1.75	
Sphyræna sphyræna	1.49 4	1.58	
Pagrus caeruleostictus	0.94 4	1.00	197
Sardinella maderensis	0.80 4	0.85	
Ariosoma sp.	0.54 2	0.58	
Trachinocephalus myops	0.54 2	0.58	
Alloteuthis africana	0.24 183	0.26	
Citharus linguatula	0.24 18	0.26	
Lesueurigobius sp.	0.02 14	0.02	
Arnoglossus imperialis	0.02 2	0.02	
Brachydeuterus auritus	0.02 2	0.02	
Total	94.17	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 33
 DATE :18.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.94
 start stop duration Lon E 6°47.11
 TIME :21:59:20 22:29:35 30.2 (min) Purpose : 2
 LOG : 345.81 347.24 1.4 Region : 3210
 FDEPTH: 59 68 Gear cond.: 0
 BDEPTH: 59 68 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 2.8 kn
 Sorted : 98 Total catch: 184.59 Catch/hour: 366.26

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Dactylopterus volitans	134.92 789	36.84	212
Pagellus bellottii	62.70 575	17.12	213
Dentex congoensis	42.86 3710	11.16	214
Ariosoma sp.	21.83 63	5.96	
Sepia officinalis	19.84 85	5.42	210
Syacium micrurum	13.10 218	3.58	
Fistularia petimba	11.90 67	3.25	
Boops boops	10.87 276	2.97	
MCTOPHIDAE	7.94 3288	2.17	
Promethichthys prometheus	6.39 187	1.74	
Galeoides decadactylus	6.07 16	1.66	216
Pseudupeneus prayensis	5.16 75	1.41	215
Octopus vulgaris	3.73 8	1.02	
Cubiiceps sp.	3.29 286	0.90	
Chilomycterus spinosus mauret.	1.79 8	0.49	
Pseudolithus senegalensis	1.77 2	0.48	
Pomadasy incisivus	1.71 8	0.47	211
Uranoscopus polli	1.55 4	0.42	
Ophichthys ophis	1.19 4	0.33	
Ophidion sp.	0.99 87	0.27	
Trachinus armatus	0.95 12	0.26	
Shrimps, small, non comm.	0.83 722	0.23	
Torpedo torpedo	0.79 2	0.22	
Cepola sp.	0.56 71	0.15	
Microchirus frechkopi	0.52 8	0.14	
Apogon sp.	0.44 56	0.12	
Physiculus cf huloti	0.36 16	0.10	
Lepidotrigla carolae	0.32 8	0.09	
Trachinocephalus myops	0.24 4	0.07	
Citharus linguatula	0.24 16	0.07	
Decapterus punctatus	0.24 8	0.07	
Arnoglossus imperialis	0.24 52	0.07	
Squilla mantis	0.16 4	0.04	
Pagrus caeruleostictus	0.16 4	0.04	
Bothus podas africanus	0.12 4	0.03	
C E F A L O P O D A	0.02 4	0.03	
Lesueurigobius sp.	0.08 20	0.02	
Physiculus cyanostropheis	0.08 8	0.02	
Synagrops bellus	0.08 8	0.02	
Stomias sp.	0.04 4	0.01	
Cronius ruber	0.04 4	0.01	
NETRASPOMATIDAE	0.04 4	0.01	
Gadella imberbis	0.04 4	0.01	
Apsilus fuscus	0.01 4	0.00	
Gobidae sp. 'bars'	0.00 2	0.00	
Tetradonthidae - juvenile	0.00 2	0.00	
Total	366.26	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 34
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°9.93
 start stop duration Lon E 6°42.61
 TIME :23:57:22 00:28:02 30.7 (min) Purpose : 2
 LOG : 355.42 356.94 1.5 Region : 3210
 FDEPTH: 64 55 Gear cond.: 0
 BDEPTH: 64 55 Validity : 0
 Towing dir: 0° Wire out : 175 m Speed : 3.0 kn
 Sorted : 81 Total catch: 135.88 Catch/hour: 265.82

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Pagellus bellottii	58.30 470	21.93	223
Dactylopterus volitans	50.08 219	18.84	221
Galeoides decadactylus	24.06 57	9.05	218
Dentex congoensis	22.89 1336	8.61	222
Syacium micrurum	13.11 112	4.93	
MYCTOPHIDAE	11.74 2934	4.42	
Brotula barbata	10.66 33	4.01	219
Boops boops	8.65 182	3.25	
Pseudupeneus prayensis	8.49 90	3.19	224
Promethichthys prometheus	8.41 227	3.16	
Physiculus cyanostropheus	5.40 209	2.03	
Sepia officinalis	5.32 6	2.00	217
Citharus linguatula	5.24 203	1.97	
Pagrus caeruleostictus	4.58 47	1.72	225
Fistularia petimba	4.30 16	1.62	
Chilomycterus spinosus mauret.	3.33 12	1.25	
Sepia officinalis	2.66 184	1.00	
Epinephelus aeneus	2.15 2	0.81	220
Fomadasy rogeri	2.11 2	0.79	226
Paetodes belcheri	1.70 4	0.64	
Grammolites gruvelli	1.41 31	0.53	
ARCIDAE	1.41 51	0.53	
Fomadasy incisivus	1.37 12	0.52	
Chelidonichthys gabonensis	1.17 4	0.44	
Bathyrcongiger vicinus	0.94 47	0.35	
NETTASTOMATIDAE	0.90 90	0.34	
Lesueurigobius sp.	0.78 235	0.29	
Lepidotrigla carolae	0.51 27	0.19	
Microchirus frechkopi	0.51 12	0.19	
S A S T R O P O D S	0.47 8	0.18	
Calappa pelii	0.47 8	0.18	
Cubiceps sp.	0.47 43	0.18	
Apogon sp.	0.39 0	0.15	
Umbina canariensis	0.31 2	0.12	
Cepola sp.	0.23 27	0.09	
Arnoglossus imperialis	0.23 59	0.09	
Plesionika martia	0.23 98	0.09	
PARALEPIDIDAE	0.20 8	0.07	
Physiculus cf huloti	0.20 23	0.07	
Decapterus punctatus	0.08 4	0.03	
GONEPLACIDAE	0.08 16	0.03	
FORTUNIDAE	0.04 4	0.01	
Thorogobius sp.	0.04 8	0.01	
Sardinella maderensis	0.04 12	0.01	
'Calappa baby'	0.04 12	0.01	
MURICIDAE	0.04 4	0.01	
Decapterus punctatus, juvenile	0.04 4	0.01	
Synagrops bellus	0.04 4	0.01	
Total	265.82	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 35
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.81
 start stop duration Lon E 6°47.09
 TIME :03:06:28 03:37:10 30.7 (min) Purpose : 2
 LOG : 369.31 370.81 1.5 Region : 3210
 FDEPTH: 60 71 Gear cond.: 0
 BDEPTH: 60 71 Validity : 0
 Towing dir: 0° Wire out : 185 m Speed : 2.9 kn
 Sorted : 65 Total catch: 77.83 Catch/hour: 152.06

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Dactylopterus volitans	45.52 270	29.94	227
Pagellus bellottii	29.50 291	19.40	228
Dentex congoensis	22.23 3468	14.62	232
Promethichthys prometheus	13.09 436	8.61	
Ariosophia sp.	8.99 39	5.91	
MYCTOPHIDAE	6.64 1803	4.37	
Sepia officinalis	6.35 51	4.18	231
Boops boops	4.49 164	2.96	
Syacium micrurum	3.81 27	2.51	
Galeoides decadactylus	2.81 8	1.85	230
Pseudupeneus prayensis	1.54 21	1.02	229
Chilomycterus spinosus mauret.	0.70 4	0.46	
Fistularia petimba	0.68 4	0.45	
Ophidion sp.	0.66 57	0.44	0
Decapterus punctatus	0.66 25	0.44	0
Grammolites gruvelli	0.47 8	0.31	0
Citharus linguatula	0.39 12	0.26	0
ARCIDAE	0.39 16	0.26	0
Octopus vulgaris	0.33 2	0.22	0
Bathyrcongiger vicinus	0.23 8	0.15	0
Fistularia petimba, juvenile	0.21 8	0.14	0
Physiculus cyanostropheus	0.21 14	0.14	0
Cubiceps sp.	0.21 20	0.14	0
Ophidion sp.	0.20 16	0.13	0
Trachinus armatus	0.20 4	0.13	0
Starfish	0.18 6	0.12	0
Fomadasy incisivus	0.18 2	0.12	0
Fistularia petimba	0.16 8	0.10	0
Bothus podas africanus	0.16 8	0.10	0
Cepola sp.	0.12 14	0.08	0
NETTASTOMATIDAE	0.12 4	0.08	0
ARCIDAE	0.12 6	0.08	0
'Mole crab'	0.08 8	0.05	0
Grammolites gruvelli	0.08 2	0.05	0
Lesueurigobius sp.	0.08 41	0.05	0
Paranthias furcifer	0.04 2	0.03	0
Solenocera africana	0.04 16	0.03	0
Bathyrcongiger vicinus	0.04 2	0.03	0
Antennarius sp.	0.04 2	0.03	0
Decapterus punctatus	0.04 2	0.03	0
Arnoglossus imperialis	0.02 2	0.01	0
MURICIDAE	0.02 2	0.01	0
Squilla mantis	0.02 2	0.01	0
Apsilus fuscus, juvenile	0.00 2	0.00	0
Total	152.06	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 36
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°9.86
 start stop duration Lon E 6°42.55
 TIME :05:06:14 05:36:41 30.5 (min) Purpose : 2
 LOG : 379.62 381.20 1.6 Region : 3210
 FDEPTH: 65 55 Gear cond.: 0
 BDEPTH: 65 55 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 3.1 kn
 Sorted : 160 Total catch: 159.72 Catch/hour: 314.72

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Galeoides decadactylus	130.05 260	41.32	235
Pagellus bellottii	47.59 266	15.12	
Drepane africana	34.09 63	10.83	
Selar crumenophthalmus	12.12 37	3.85	
Fomadasy incisivus	11.82 93	3.76	
Brotula barbata	10.34 16	3.29	
Fomadasy rogeri	7.29 8	2.32	233
Syacium micrurum	7.29 71	2.32	
Dactylopterus volitans	6.50 33	2.07	234
Chilomycterus spinosus mauret.	5.42 26	1.72	
Pagrus caeruleostictus	5.32 39	1.69	
Pseudupeneus prayensis	4.73 35	1.50	
Sphyræna sphyraena	4.71 16	1.50	
Priacanthus arenatus	4.43 16	1.41	
Paetodes belcheri	4.16 12	1.32	
Chaetodipterus goereensis	3.61 2	1.15	
Octopus vulgaris	1.83 4	0.58	
Epinephelus aeneus	1.48 2	0.47	
Albula vulpes	1.44 2	0.46	
Uraspis secunda	1.44 2	0.46	
Fistularia petimba	1.40 4	0.44	
Dentex congoensis	1.12 30	0.36	
Chilomycterus spinosus mauret.	1.06 5	0.34	
Alloteuthis africana	0.99 256	0.31	
Citharus linguatula	0.89 32	0.28	
Chelidonichthys gabonensis	0.85 6	0.27	
Invertebrate	0.59 20	0.19	
CONGRIDAE	0.53 2	0.17	
Lutjanus fulgens	0.47 2	0.15	
Scorpaeni laevis	0.35 2	0.11	
Saurida brasiliensis	0.26 77	0.08	
Torpedo torpedo	0.24 4	0.08	
Arnoglossus imperialis	0.16 8	0.05	
C E P H A L O P O D A	0.06 30	0.02	
Paranthias furcifer	0.04 2	0.01	
Serranus sp. Heemstra	0.04 6	0.01	
Cepola sp.	0.02 2	0.01	
Total	314.72	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 37
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.91
 start stop duration Lon E 6°47.11
 TIME :08:02:57 08:32:59 30.0 (min) Purpose : 2
 LOG : 395.72 397.11 1.4 Region : 3210
 FDEPTH: 60 68 Gear cond.: 0
 BDEPTH: 60 68 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 2.8 kn
 Sorted : 87 Total catch: 87.18 Catch/hour: 174.24

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Pagellus bellottii	70.25 362	40.32	
Dactylopterus volitans	68.85 456	39.52	
Sepia officinalis	19.79 60	11.36	
Fistularia petimba	3.80 14	2.18	
Dentex congoensis	3.80 260	2.18	
Syacium micrurum	2.56 14	1.47	
Pseudupeneus prayensis	2.36 32	1.35	
Chilomycterus spinosus mauret.	1.00 6	0.57	
Acanthostracion guineensis	0.82 2	0.47	
Decapterus punctatus	0.40 18	0.23	
Pagrus caeruleostictus	0.32 6	0.18	
C E P H A L O P O D A	0.26 150	0.15	
Citharus linguatula	0.04 2	0.02	
Total	174.24	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 38
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°9.90
 start stop duration Lon E 6°42.59
 TIME :10:00:48 10:31:00 30.2 (min) Purpose : 2
 LOG : 403.94 405.40 1.5 Region : 3210
 FDEPTH: 65 57 Gear cond.: 0
 BDEPTH: 65 57 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 2.9 kn
 Sorted : 99 Total catch: 98.55 Catch/hour: 195.73

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Drepane africana	53.62 121	27.40	
Galeoides decadactylus	51.44 137	26.28	
Pagellus bellottii	32.57 141	16.64	
Pagrus caeruleostictus	10.53 48	5.38	
Selene dorsalis	7.94 20	4.06	
Fomadasy incisivus	6.34 46	3.24	
Sepia officinalis	5.94 16	3.03	
Octopus vulgaris	5.22 6	2.67	
Brotula barbata	4.47 4	2.28	
Pseudupeneus prayensis	4.17 50	2.13	
Syacium micrurum	3.10 34	1.58	
Dactylopterus volitans	2.78 20	1.42	
Branchiostegus semifasciatus *	2.60 2	1.33	
Brachydeuterus aurifus	1.93 16	0.98	
Citharus linguatula	1.17 38	0.60	
Paetodes belcheri	0.83 2	0.43	
Decapterus punctatus	0.58 2	0.29	
Lesueurigobius sp.	0.14 32	0.07	
Microchirus frechkopi	0.14 4	0.07	
Alloteuthis africana	0.12 91	0.06	
Grammolites gruvelli	0.10 2	0.05	
Total	195.73	100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 39
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.74
 start stop duration Purpose : 2
 TIME :12:59:56 13:30:26 30.5 (min) Region : 3210
 LOG : 416.99 418.31 1.3 Gear cond.: 0
 FDEPTH: 62 71 Validity : 0
 BDEPTH: 62 71
 Towing dir: 0° Wire out : 180 m Speed : 2.6 kn
 Sorted : 124 Total catch: 124.33 Catch/hour: 244.58

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	129.84	855	53.08	241
Pagellus bellottii	64.92	461	26.54	240
Sepia officinalis	18.49	65	7.56	237
Dentex congoensis	9.05	384	3.70	236
Pseudupeneus prayensis	4.37	47	1.79	238
Octopus vulgaris	3.86	6	1.58	
Fistularia petimba	3.74	14	1.53	
Syacium micrurum	1.97	14	0.80	
Pagrus caeruleostictus	1.85	14	0.76	239
Ballistes caprisiscus	1.24	2	0.51	
Chilomycterus spinosus mauret.	1.16	8	0.47	
Alloteuthis africana	1.06	464	0.43	
Galeoides decadactylus	0.92	4	0.38	
Aluterus monoceros	0.69	2	0.28	
Drepane africana	0.63	2	0.26	
Seriola carpenteri	0.41	2	0.17	
ARCIDAE	0.18	4	0.07	
Starfish	0.16	4	0.06	
Citharus linguatula	0.04	8	0.02	
Arnoglossus imperialis	0.02	2	0.01	
Total	244.58		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 40
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°8.84
 start stop duration Purpose : 2
 TIME :15:07:54 15:38:19 30.4 (min) Region : 3210
 LOG : 429.93 431.51 1.6 Gear cond.: 0
 FDEPTH: 57 65 Validity : 0
 BDEPTH: 57 65
 Towing dir: 0° Wire out : 175 m Speed : 3.1 kn
 Sorted : 120 Total catch: 120.40 Catch/hour: 237.48

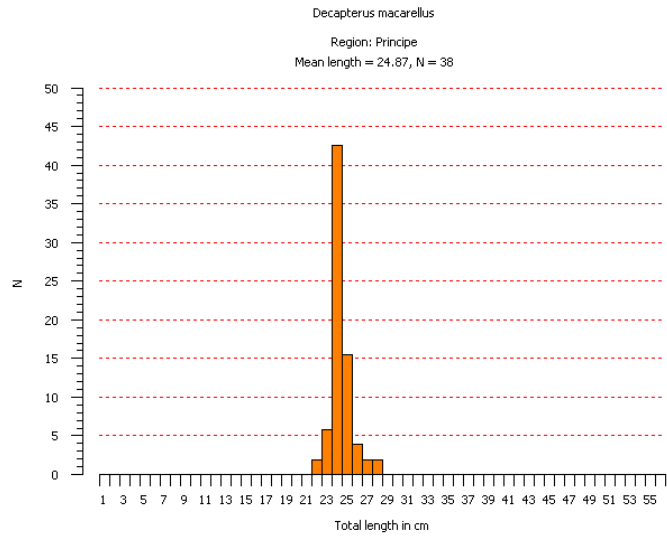
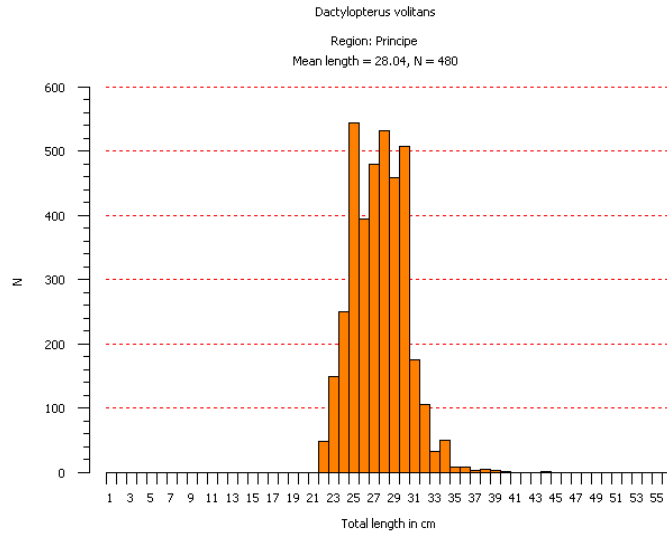
SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Galeoides decadactylus	63.51	181	26.74	246
Drepane africana	51.87	116	21.84	
Pagrus caeruleostictus	31.18	73	13.13	242
Pagellus bellottii	27.32	146	11.50	245
Dactylopterus volitans	13.12	69	5.52	243
Pomadasy rogeri	7.51	8	3.16	247
Pomadasy incisus	7.46	49	3.14	249
Pseudupeneus prayensis	7.04	99	2.97	244
Brotula barbata	4.64	18	1.95	
Syacium micrurum	4.16	22	1.75	
Sphyrna sphyraena	3.06	12	1.29	250
Branchiostegus semifasciatus *	2.29	2	0.96	
Citharus linguatula	1.81	61	0.76	
Psettodes belcheri	1.78	4	0.75	
Saurida brasiliensis	1.78	43	0.75	
Albula vulpes	1.68	2	0.71	
Dentex congoensis	1.64	82	0.69	248
Aluterus monoceros	1.18	2	0.50	
Fistularia petimba	0.65	2	0.27	
Sardinella maderensis	0.61	4	0.26	
Sepia officinalis	0.53	36	0.22	
Lesueurigobius sp.	0.51	120	0.22	
Octopus vulgaris	0.51	4	0.22	
Grammolites grueli	0.39	8	0.17	
Ubrina canariensis	0.32	2	0.13	
Chilomycterus spinosus mauret.	0.30	2	0.12	
Alloteuthis africana	0.16	83	0.07	
Thorogobius sp.	0.12	30	0.05	
Bathyracoconger vicinus	0.06	2	0.02	
Friacanthus arenaeus	0.06	4	0.02	
Brachydeuterus auritus, juvenile	0.06	10	0.02	
Calappa pelii	0.06	6	0.02	
Arnoglossus imperialis	0.04	6	0.02	
'Mole crab'	0.04	6	0.02	
Physiculus cf huloti	0.02	2	0.01	
G A S T R O P O D S	0.02	16	0.01	
Total	237.48		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2010405 STATION: 41
 DATE :19.05.2010 GEAR TYPE: BT NO: 24 POSITION:Lat N 0°15.75
 start stop duration Purpose : 2
 TIME :18:01:19 18:30:55 29.6 (min) Region : 3210
 LOG : 441.17 442.55 1.4 Gear cond.: 0
 FDEPTH: 63 72 Validity : 0
 BDEPTH: 63 72
 Towing dir: 0° Wire out : 175 m Speed : 2.8 kn
 Sorted : 111 Total catch: 111.04 Catch/hour: 225.16

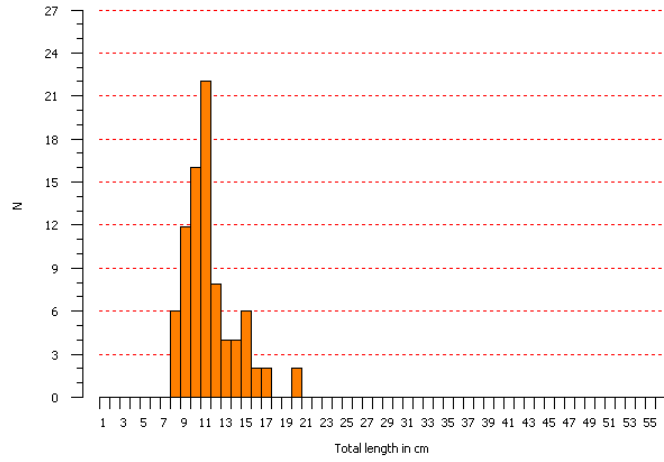
SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Dactylopterus volitans	77.05	502	34.22	251
Albula vulpes	47.25	69	20.98	
Pagellus bellottii	29.20	207	12.97	252
Sepia officinalis	16.73	55	7.43	257
Syacium micrurum	9.14	85	4.06	
Dentex congoensis	8.11	578	3.60	253
Boops boops	6.37	310	2.83	258
Galeoides decadactylus	5.88	26	2.61	255
Pseudupeneus prayensis	5.47	85	2.43	256
Promethichthys prometheus	4.50	132	2.00	
Fistularia petimba	3.35	6	1.49	
Cubiceps sp.	3.04	397	1.35	
Ariosoma sp.	2.82	10	1.25	
Pomadasy rogeri	2.03	2	0.90	
Pagrus caeruleostictus	1.22	12	0.54	254
Pomadasy incisus	0.61	4	0.27	
Chilomycterus spinosus mauret.	0.61	2	0.27	
Citharus linguatula	0.49	12	0.22	
Trachinocephalus myops	0.45	4	0.20	
Dicologlossa hexophthalma	0.36	4	0.16	
Decapterus punctatus	0.26	14	0.12	
Arnoglossus imperialis	0.12	26	0.05	
MURICIDAE	0.06	2	0.03	
Bothus podas africanus	0.04	2	0.02	
Total	225.16		100.00	

Annex II Length distributions of main species

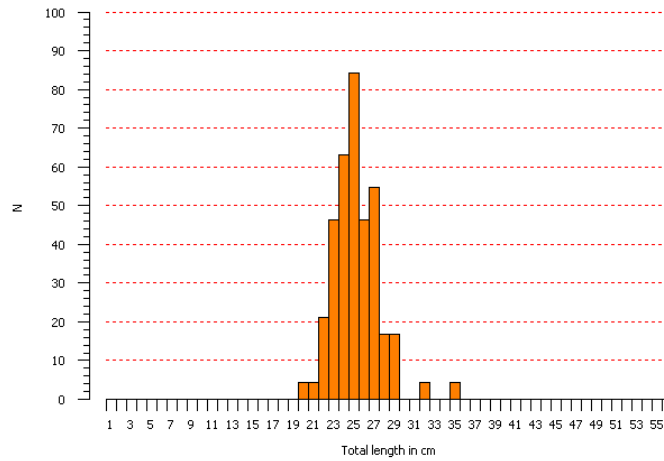
Príncipe



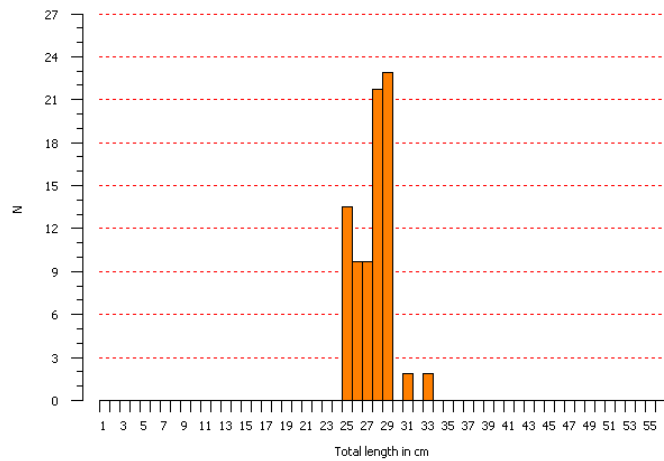
Dentex congopus
Region: Principe
Mean length = 11.91, N = 42



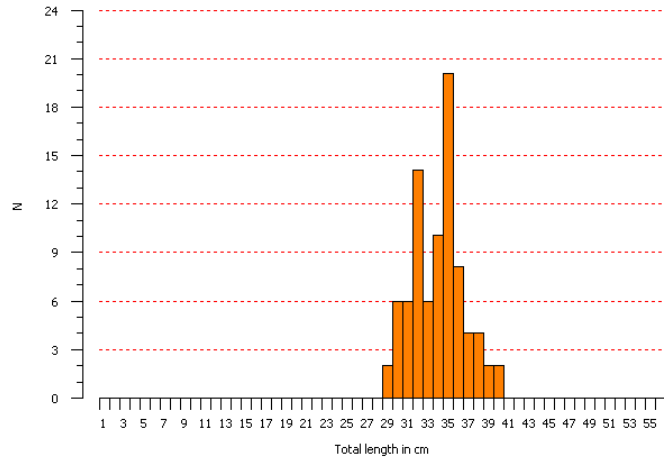
Drepane africana
Region: Principe
Mean length = 25.74, N = 87



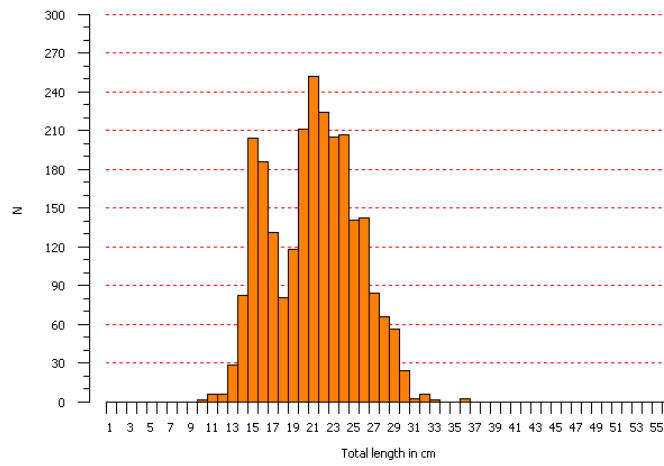
Lethrinus atlanticus
Region: Principe
Mean length = 28.12, N = 41



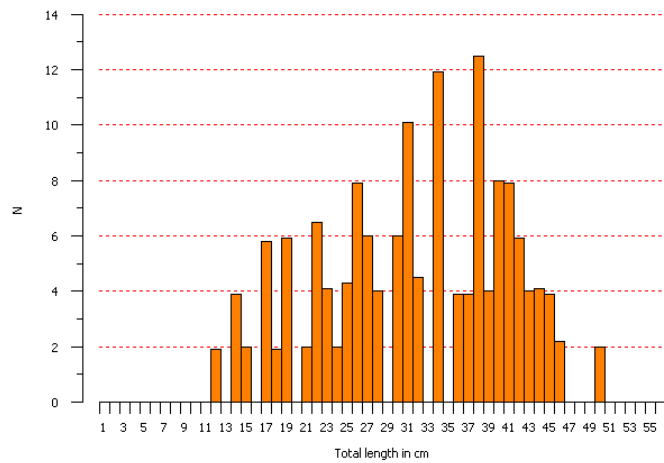
Lutjanus fulgens
Region: Principe
Mean length = 34.5, N = 42

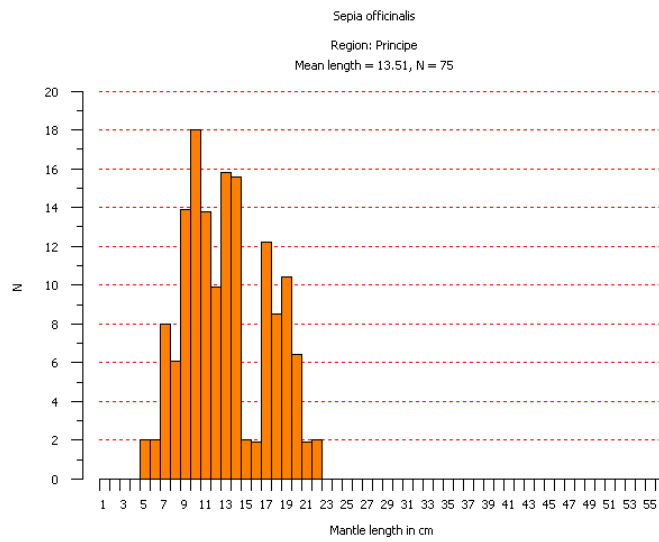
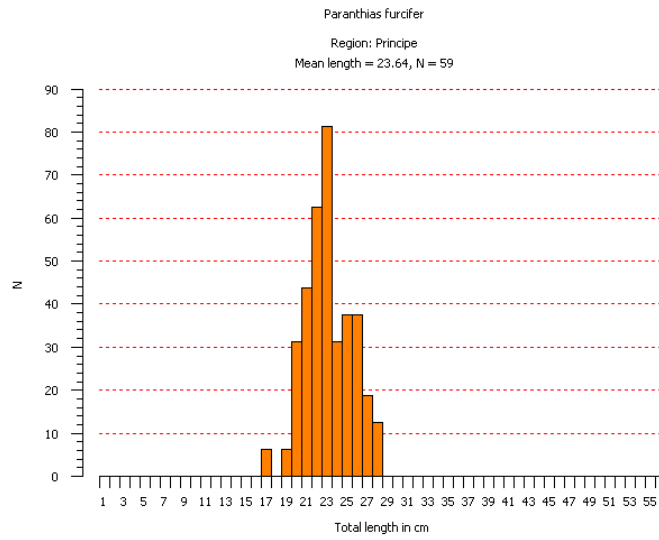


Pagellus bellotti
Region: Principe
Mean length = 21.5, N = 627

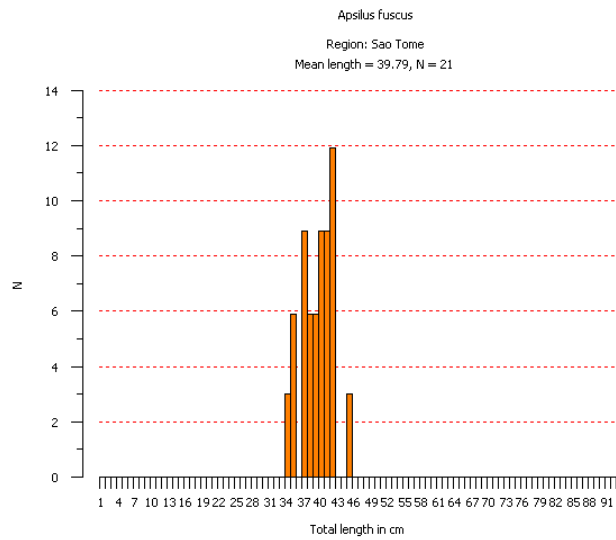


Pagrus caeruleostictus
Region: Principe
Mean length = 32.16, N = 76

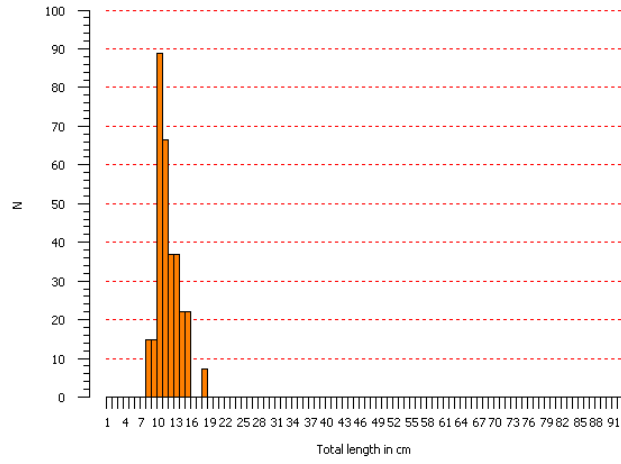




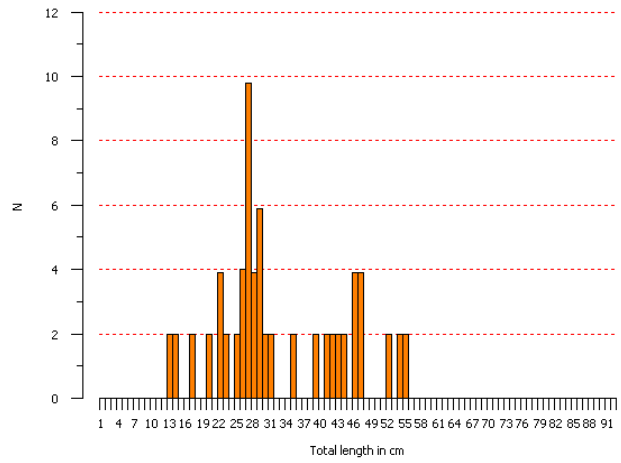
São Tomé



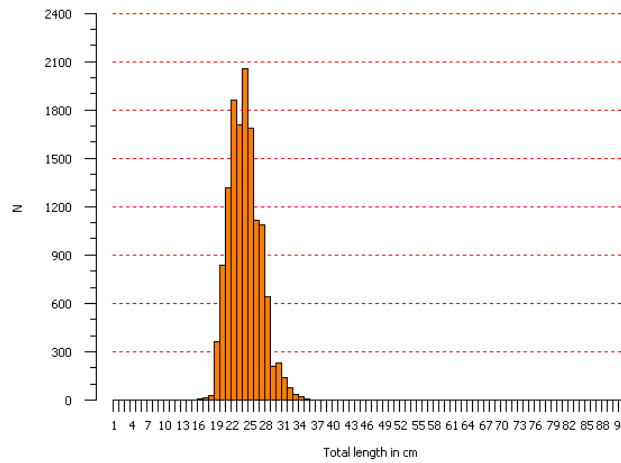
Boops boops
Region: Sao Tome
Mean length = 12, N = 42

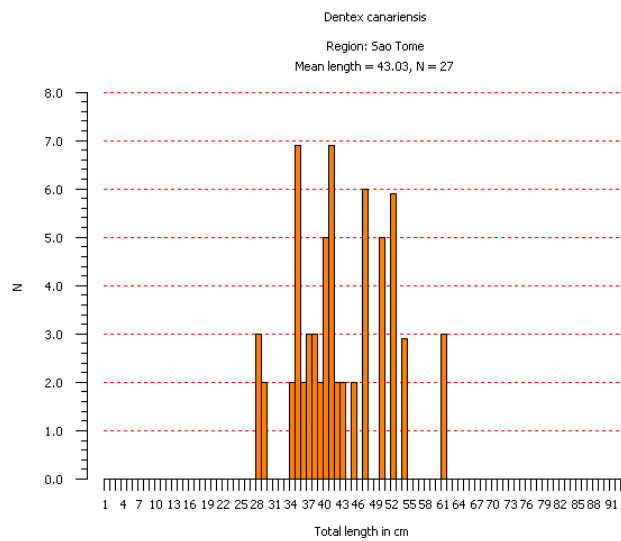
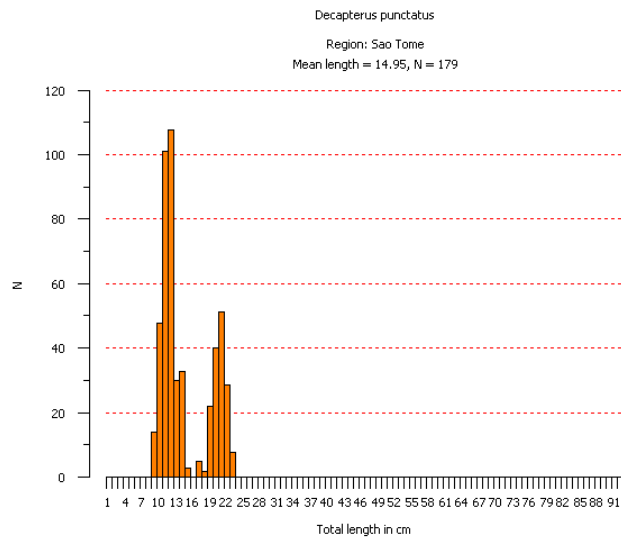
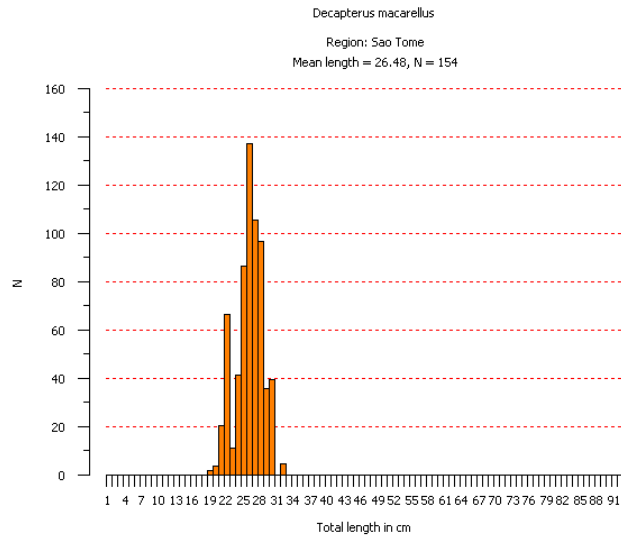


Brotula barbata
Region: Sao Tome
Mean length = 33.03, N = 35

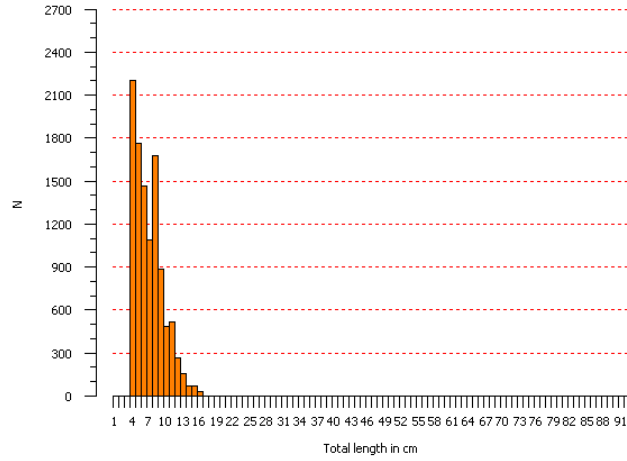


Dactylopterus voltans
Region: Sao Tome
Mean length = 24.46, N = 1333

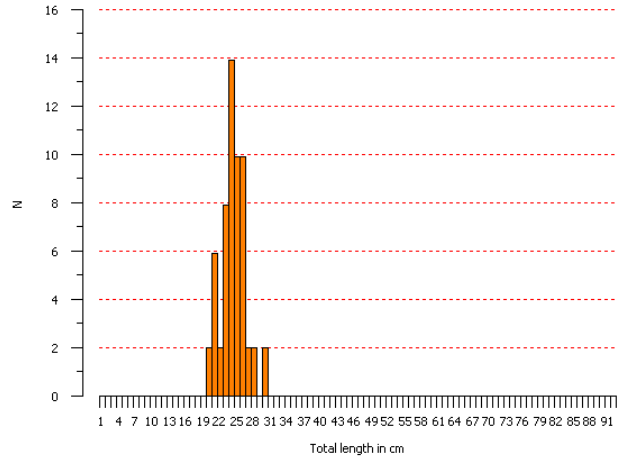




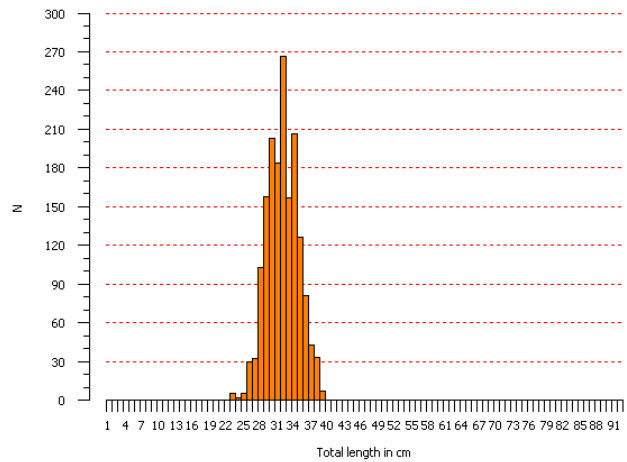
Dentex congoensis
Region: Sao Tome
Mean length = 7.36, N = 717

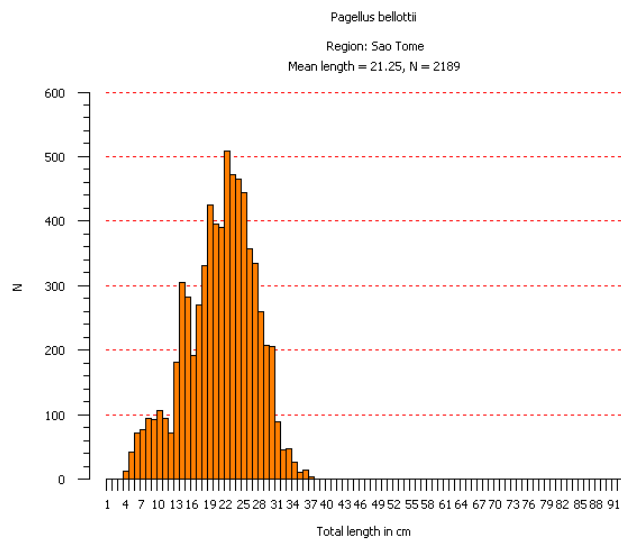
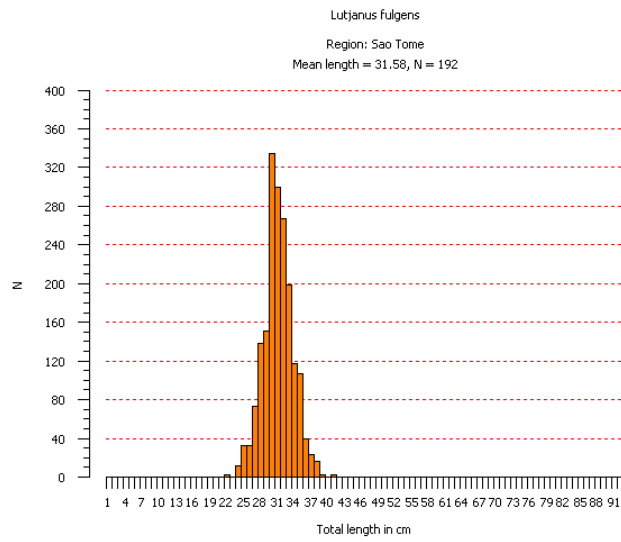
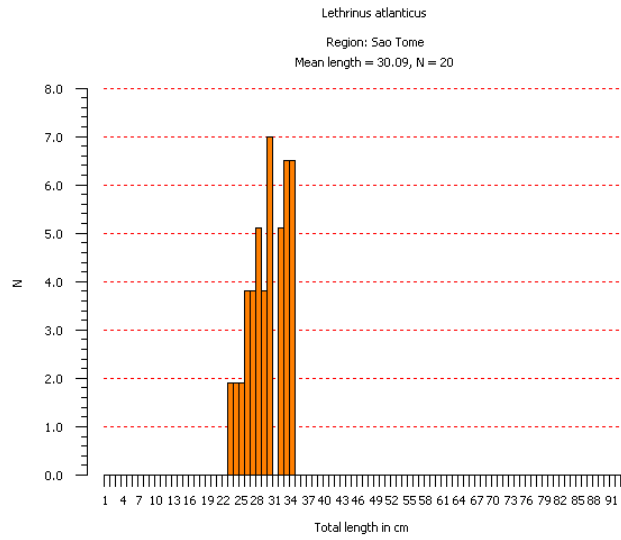


Drepane africana
Region: Sao Tome
Mean length = 24.81, N = 29

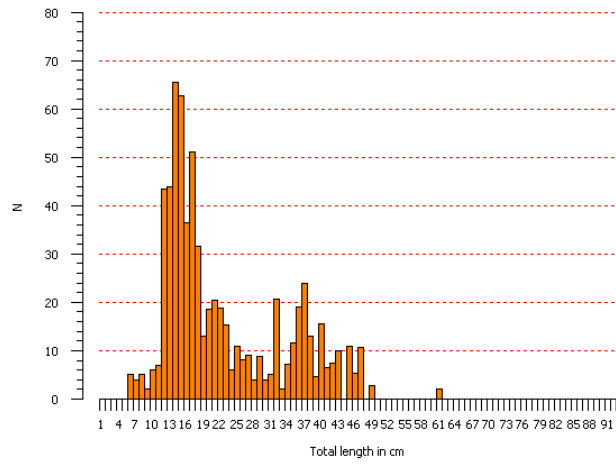


Galeoides decadactylus
Region: Sao Tome
Mean length = 32.4, N = 375

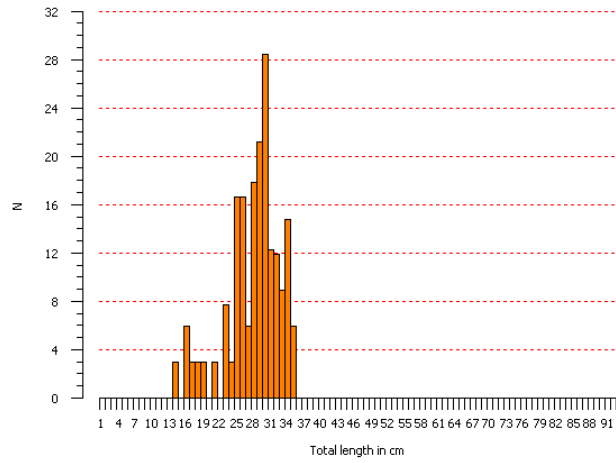




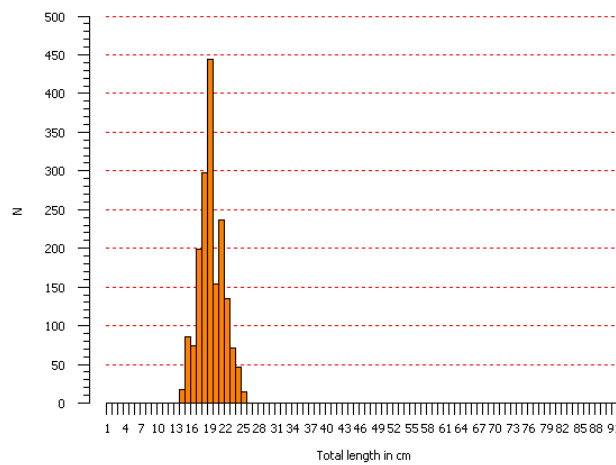
Pagrus caeruleostictus
Region: Sao Tome
Mean length = 23.03, N = 292

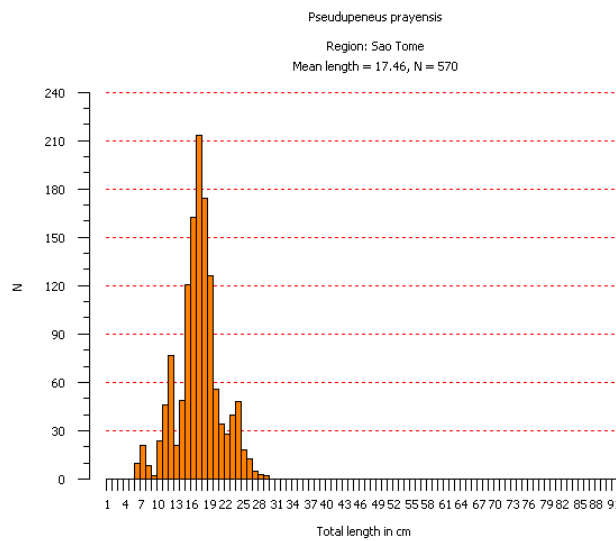
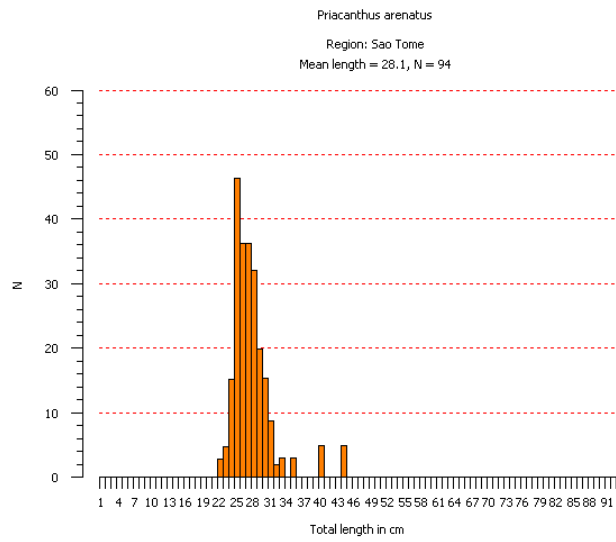
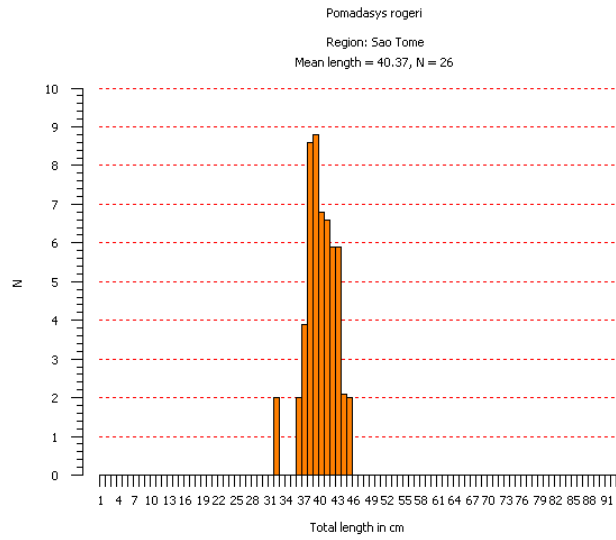


Paranthias furcifer
Region: Sao Tome
Mean length = 28.38, N = 60

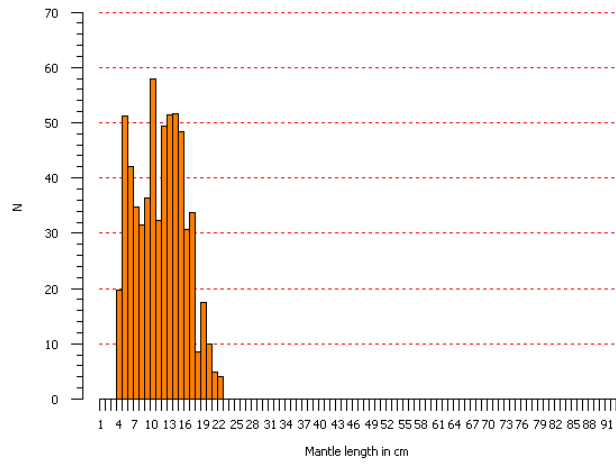


Pomadasys incisus
Region: Sao Tome
Mean length = 19.67, N = 236

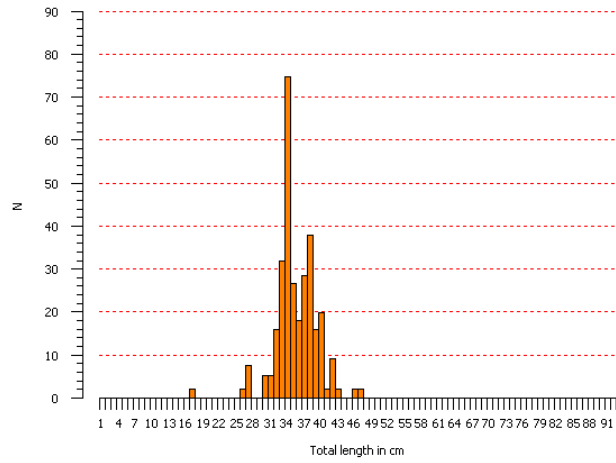




Sepia officinalis
Region: Sao Tome
Mean length = 11.7, N = 307



Sphyræna sphyræna
Region: Sao Tome
Mean length = 35.94, N = 68



Sao Tome

SPECIES NAME	Lower limits, Kg/nm				% incidence	Mean dens. t/nm ²	Mean dens. by btm. depth strata t/nm ²		
	>0	10	30	100			0-30m	30-50m	50-100m
<i>Dactylopterus volitans</i>	2	2	4		100	4.127	7.528	5.618	3.311
<i>Lutjanus fulgens</i>	1	1		1	37.5	3.042			4.056
<i>Pagellus bellottii</i>	1	5	2		100	1.755	0.174	1.298	2.095
<i>Galeoides decadactylus</i>	1	1	1		37.5	0.816			1.088
<i>Pomadasys incisus</i>	2		1		37.5	0.578			0.771
<i>Decapterus macarellus</i>	2		1		37.5	0.516	0.216		0.652
<i>Acanthurus monroviae</i>			1		12.5	0.51			0.68
<i>Chelonia mydas</i>			1		12.5	0.492	3.933		
<i>Sepia officinalis</i>	8				100	0.316	0.191	0.048	0.381
<i>Dentex canariensis</i>	2	1			37.5	0.313			0.418
<i>Sphyaena sphyaena</i>	3	1			50	0.256	1.685		0.06
<i>Pagrus caeruleostictus</i>	6				75	0.232	0.012	0.393	0.241
<i>Paranthias furcifer</i>	1	1			25	0.189			0.252
<i>Pseudupeneus prayensis</i>	8				100	0.185	0.022	0.097	0.227
<i>Fistularia petimba</i>	6				75	0.184		0.02	0.242
<i>Apsilus fuscus</i>	1	1			25	0.165			0.22
<i>Epinephelus aeneus</i>	1	1			25	0.162			0.216
<i>Lagocephalus lagocephalus DEAD</i>		1			12.5	0.154	1.236		
<i>Priacanthus arenatus</i>	3				37.5	0.139			0.185
<i>Lethrinus atlanticus</i>	3				37.5	0.092	0.247	0.41	0.014
<i>Decapterus punctatus</i>	4				50	0.078	0.413	0.001	0.035
<i>Acanthostracion quadricornis</i>	2				25	0.072	0.539		0.006
<i>Syacium micrurum</i>	6				75	0.071		0.002	0.094
<i>Balistes capriscus</i>	2				25	0.064		0.481	0.006
<i>Carangoides bartholomaei</i>	1				12.5	0.052			0.069
<i>Dentex congoensis</i>	6				75	0.045			0.06
<i>Psettodes belcheri</i>	3				37.5	0.04			0.053
<i>Chilomycterus spinosus mauret.</i>	6				75	0.039	0.055		0.043
<i>Balistes punctatus</i>	2				25	0.037	0.23	0.064	
<i>Lutjanus goreensis</i>	1				12.5	0.032			0.043
<i>Selene dorsalis</i>	3				37.5	0.031			0.042
<i>Seriola carpenteri</i>	4				50	0.028		0.047	0.03
<i>Octopus vulgaris</i>	3				37.5	0.023		0.051	0.023
<i>Bothus guibeii</i>	1				12.5	0.023	0.183		
<i>Aluterus heudelotii</i>	3				37.5	0.021	0.057		0.018
<i>Alloteuthis africana</i>	2				25	0.018		0.127	0.003
<i>Citharus linguatula</i>	4				50	0.016			0.022
Other fish						0.086	0.135	0.031	0.088
Sum all species						15.065	16.916	8.688	15.819
Sum SNAPPERS, JOBFISHES						3.239			4.319
Sum GROUPERS, SEABASSES						0.352			0.469
Sum GRUNTS, SWEETLIPS						0.592			0.789
Sum CROAKERS, DRUMS, WEAKF., KOBS									
Sum PANDORAS, PORGIES, SEABREAMS,						2.359	0.186	1.691	2.832
Sum SHARKS, CHIMAERAS									
Sum BATOID FISHES, RAYS						0.009	0.006		0.012
Sum CEPHALOPODS						0.357	0.191	0.226	0.407
Numbers of stations included in analysis, total and by depth strata						8	1	1	6

Annex IV Instruments and fishing gear used

The Simrad ER-60 scientific echo sounder connected to 18, 38, 120 and 200 kHz transducers was run during the survey only for observation of fish and bottom conditions. No scrutinizing of the recordings was done.

Last standard sphere calibrations were carried out 07.03.2010 in Baia dos Elefantes. Angola using Cu-64, Cu-60, WC-38.1 add WC-38.1 spheres for 18, 38, 120 and 200 kHz, respectively. The details of the settings of the 38 kHz echo sounder where as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	5.50 m
Absorbtion coeff.	8,5 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2,43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
gain	25,23 dB
SA correction	-0,51 dB
Angle sensitivity	21.9
3 dB beamwidth	7,35° along ship 7,31° athwardship
Alongship offset	-0.05°
Athwardship offset	0.06°

Bottom detection menu Minimum level -40 dB

Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super bottom trawl". During the present survey only the bottom trawl was used.

The bottom trawl has a headline of 31 m, footrope 47 m and 20 mm mesh size in the codend with an inner net of 10 mm mesh size. The trawl height was about 4.5 m and distance between wings during towing about 21 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. Since 19.02.08 new and heavier "Thyborøn" combi trawl doors (7.41 m², 1720 kg) have been in used. During the present survey the door distance was kept nearly constant at about 50 m at all depths by the use of a 9 m strap between the wires at 120 m distance from the doors (normally applied at depths greater than 80 m). At depths greater than 300 m the trawl was equipped with a tickler chain, which improves the catchability of bottom living and borrowing species, particularly shrimps.

The SCANMAR system was used on all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance, and the trawl was equipped with a trawl eye that provides information about the trawl opening. A catch sensor on the cod-end indicated the size of the catch.

Annex V Preliminary report on registrations of *Lagocephalus lagocephalus* die off

INVESTIGATION INTO CAUSE OF MASS MORTALITY OF *LAGOCEPHALUS LAGOCEPHALUS* OFF SÃO TOMÉ – MAY 2010

Introduction and background

The Oceanic pufferfish *Lagocephalus lagocephalus* (Linnaeus, 1758) (locally called Rabbit fish or Rabbit puffer) (Fig. 1) is a widely distributed species of the large family of pufferfishes, the Tetraodontidae. This group is renowned for the deadly tetraodotoxin poison that permeates the body parts of many species, with some more toxic than others. Several species are highly prized in Japan where they are known as fugu and are served in select high-end restaurants that specialize in this delicacy, and which must be prepared by highly-trained licensed chefs. The Oceanic pufferfish, as its name implies, is primarily pelagic in its habit, but occasionally will stray into inshore waters. Its closely similar relative in eastern Atlantic waters, the Smooth pufferfish *Lagocephalus laevigatus* Linnaeus, 1766, is similar in many characteristics but is commonly in coastal waters, although occasionally found offshore to the edge of the continental shelf at depths approaching 200 m. The Oceanic pufferfish is found off the island of São Tomé where it forms a small artisanal fishery for local consumption.

A mass die-off and strandings of dead Oceanic pufferfish along beaches off São Tomé was reported by residents and biologists of the Ministry of Fisheries beginning around the first part of the month of May. While conducting a survey of the fishery resources of São Tomé and Príncipe for the country's government, scientists aboard the Norwegian fishery research vessel *Dr Fridtjof Nansen* were requested to conduct an investigation as to the possible cause of the phenomenon. During the second week of the survey on the 14/05-2010 at 15:23 while on the southeastern coast of São Tomé, the ship ran across an oceanic front approximately 4 nautical miles off the island at 0°13.8'N, 6°24.2'E. The current boundary appeared to form a line of concentration of dead puffers floating at the surface and readily visible because of their bright white belly (Figure 2). A skiff was launched and five specimens were quickly retrieved and brought to *Dr. Fridtjof Nansen*.



Figure 1. The Oceanic pufferfish, *Lagocephalus lagocephalus* (photo: O. Alvheim).

Methods and materials

Once aboard the ship, the specimens were quickly examined externally, photographed, and their species identity verified. Two of the five specimens were immediately injected with 75% ethyl alcohol and placed in a container of the alcohol at 50% concentration. Two others were injected with concentrated formalin and then placed into a container with a 10% solution of formalin and water. The fifth specimen was examined closer and sacrificed. Aside from a slightly rotten smell, the specimen appeared to be in reasonably good shape: it is likely that it had not been dead for more than a day or two. A closer examination in the laboratory showed the body muscle mass to be relatively firm, although we had no fresh specimen by which to make a comparison. The gills were still pink and not overlain with mucous, and the eyeballs were relatively clear. Internal dissection revealed a pair of well-developed testes, and some milt was discharged when first handling the fish; the small liver appeared to be that of a healthy animal. No internal parasites were visible in the peritoneal cavity or elsewhere, including the body muscles. There was no outward appearance of physical injury to the fish.

Results and discussion

From our examination we conclude that no direct physical trauma was imposed on the fish nor was there any malignant form of disease or internal parasite as the likely cause of death. Instead, we speculate that other external factors may account for the mass mortality observed off the island, for example, a sudden change in water temperature. Perhaps by coincidence the pufferfish die-off coincides with the annual strandings of large squid along the shores of the west coast of São Tomé, from the city of that name south for a short distance. It is at these times that local citizens wade the surf along the coast and catch by hand dozens of these squid for consumption. The local fishery biologists suggest that these squid strandings are a probable result of spawning aggregations—perhaps typical of many squid species, once spawned, the squid die. Oceanographic conditions off the island are scarcely known, especially on a short temporal basis. We have heard from different sources that the ocean is cooler during the times the squid “come in” to shore. If upwelling events occur that produce cold water over large areas offshore, the Oceanic pufferfish may possibly succumb to the coolness, as the species is primarily confined to oceanic waters with relatively constant (and mild) temperatures. According to our local biologist colleagues, the die-offs have been recorded only since 2007, and quite regularly at the same time of the year from March-May. Could this reflect longer-term oceanic changes that are taking place and affecting biological conditions around the island?

Other possible causes to be explored include pollution from local or external sources. Because of the tiny industrial component of the islands' economy and relatively benign agricultural component, with commercial export crops primarily cacao, palm oil, and coffee, local run-off from these sources seem unlikely pollutants that could affect oceanic fishes. The large oil-producing countries off West Africa, especially Angola and Nigeria, are so far removed from these oceanic islands as to belie any reasonable scenario that would explain how pollutants could affect the island waters to a major degree.

Poisonous “red tides” were also not observed in the surveyed area and CTD samples of the water column at the place where the dead fish were found as well as around other parts of the island did not reveal any oceanic conditions like hypoxic water masses that may have explained the phenomena. However, the water temperature was slightly higher than observed during previous surveys in the same area.

It is noteworthy that similar die-offs of Oceanic pufferfish, but on a much wider scale, have been observed on the shelf (up to 40 NM off the coast) off Gabon to northern Angola (01°00' S – 05°00') over a period of several days by one of us (JK) in mid May 2008. The collected dead or dying fish were in similar fine condition as that described during the current event.

No seismic activity, no visible pollution, and no “red tide” or similar algal bloom were observed during the May 2008 survey. The water masses were well saturated with oxygen, while water temperature in the region was higher than average. Samples of the fish sent for analyses at laboratories at the Institute of Marine Research in Norway did not reveal the cause of death.

Massive die-offs of pufferfishes off Angola have also been observed by another one of us (OA) over a period of more than 12 years of working along that and the Namibia coast aboard *Dr. Fridtjof Nansen*.

A currently existing oceanographic condition off the island could offer the key to an answer: a temperature-salinity anomaly was registered by *Dr. Fridtjof Nansen* during its transit from Accra to the islands and in the ship's tracks around the islands over the course of the survey (Figs. 2 & 3).

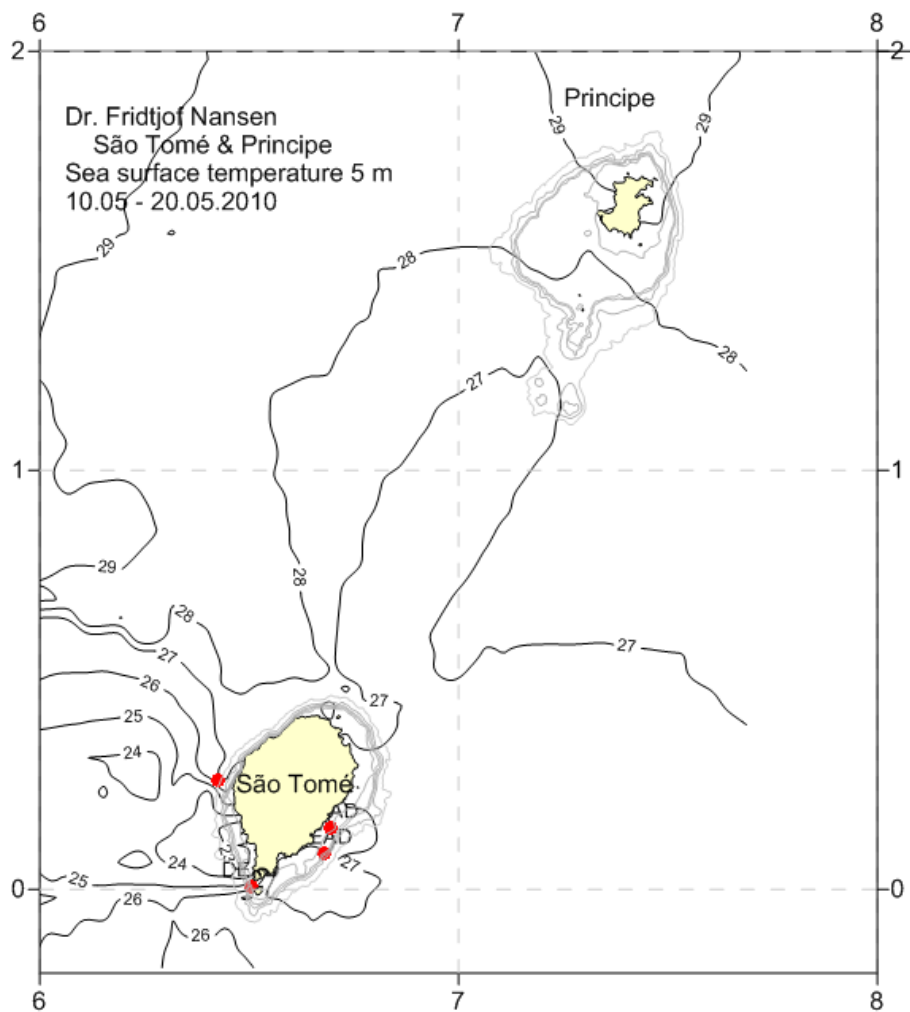


Figure 2. Surface water temperatures around São Tomé and Príncipe. Red dots depict stations where dead *Lagocephalus lagocephalus* was encountered.

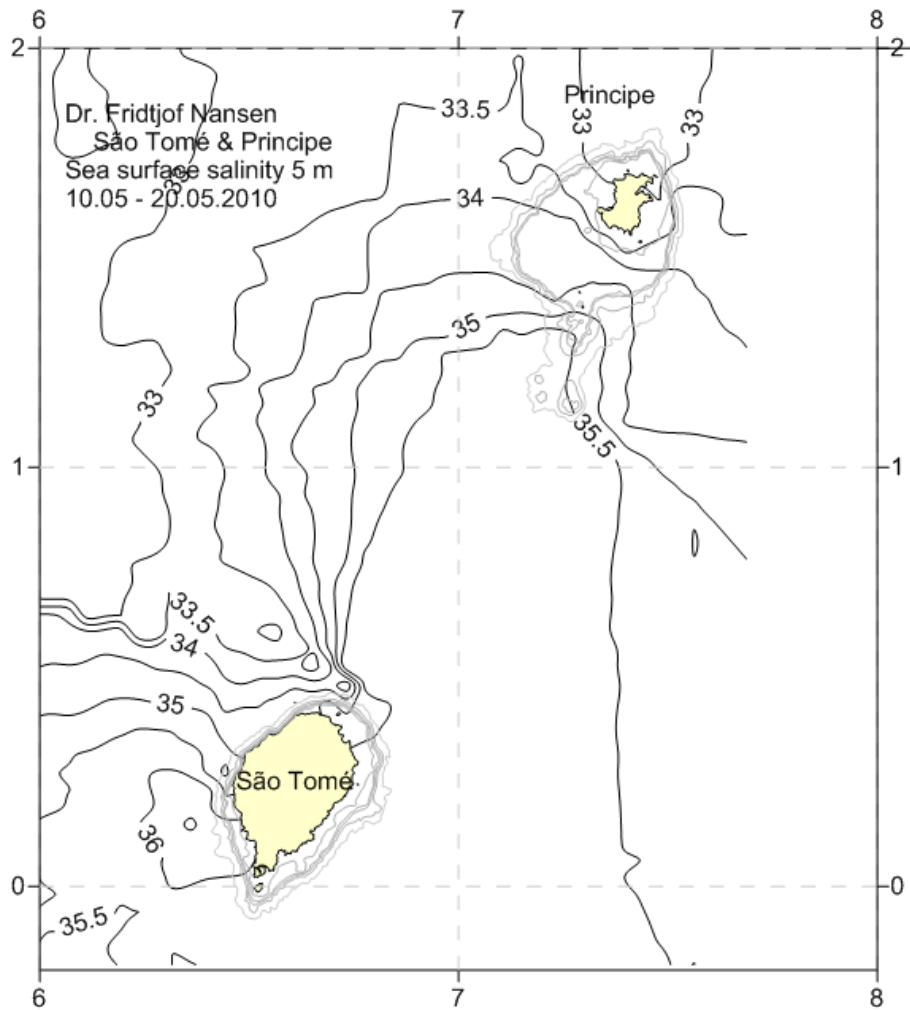


Figure 3. Surface water salinity around São Tomé and Príncipe.

It appears that a decidedly warmer (27°C - 30°C) and less saline (<33 - 35‰) water mass bathes the surface waters off Príncipe: the origin of this water mass is likely from the mainland coast of the Gulf of Guinea where large rivers discharge their loads. On the other hand, São Tomé is engulfed by cool, (22 - 28°C) higher-salinity (34 - 36‰) waters that originate from the south, with a sharp thermal front developed along the southeastern coast, perhaps a result of local upwelling.

Conclusion

We are left with no viable explanation for the recent massive die-off of Oceanic pufferfish off the island of São Tomé. At best, we can hope that oceanic observations made during the current, past, and future surveys may offer some explanation for the phenomenon. Long-term investigations and monitoring of oceanographic conditions by local scientists are vital

components of the effort needed to eventually answer this question. In this regard, we have yet to access sea-surface temperature data off São Tomé that are available at the Ministry of Fisheries, similarly, meteorological data for upwelling indexes over the previous 10 years are critical to understanding long-term changes in the water masses around the island. Perhaps answers to the causes of similar die-offs in other countries in mainland Africa will be applicable in São Tomé. That the die-off only affected one oceanic species of minor commercial importance is a positive side of this phenomenon. And that aspect —one oceanic species--should be pursued, as it may offer an explanation. At present, there is almost no information on the life history of the species, a crucial question that also needs to be addressed.

Tomio Iwamoto¹, Jens-Otto Krakstad² and Oddgeir Alvheim²

¹Academy of Sciences, San Francisco, CA 9118, USA

²Institute of Marine Research, Bergen, Norway